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MILLENNIALS!

*"It was the* HARDEST *movie I've ever done."* LEONARDO DICAPRIO on *The Revenant*

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# LEXICAL ANALYSIS

## LEX LUTHOR ON DISRUPTING THE VIGILANTE INDUSTRIAL COMPLEX

INTERVIEW BY RON TROUPE

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*The impending launch of his company's revolutionary new operating system Lex/OS (I got my hands on the beta and, yeah, it's awesome) seemed like the perfect moment to sit down with the dynamic and, at times, controversial, young genius behind the LexCorp magic to see what else he's got up his sleeve.*

*The elevator doors open and I step into the opulent Royal Penthouse Suite at the Park Metropolis Downtown. Eleven lavish bedrooms, each with its own floor-to-ceiling Italian marble bath, a 100-seat cinema/lecture hall, a four-lane bowling alley (two standard American, one duckpin, one Belgian feather), twin helipads and its own private Caffè Bene. In other words: exactly what you'd expect for $95,000 a night.*

*Of course, no one's actually staying here. This is just the space he's rented for my fifteen-minutes-but-more-like-ten, no-holds-barred-except-several interview.*

*If I didn't know better, I'd think billionaire tech wunderkind Lex Luthor was trying to intimidate me.*

RON TROUPE: Nice digs.

**LEX LUTHOR: We're not doing that.**

Doing what?

**We're not opening with a wide-eyed layman's description of the hotel room that makes me look unrelatable just to set up a dramatic twist wherein, lo and behold, you discover I'm surprisingly down-to-earth because I know the score of the last Metros game.**

Do you?

**Metros 102, Guardsmen 86.**

Weird. *(it's the correct "relatable" small talk, but coming out of him, it sounds less like a basketball score than a set of algebraic integers.)*

**Which is why we're not doing it.**

Would you say you're a man who's always gotten what he wants?

**Nice pivot. Here's mine: What I want is to leave the planet in better shape for the next generation. To make the world and its children safer. I want it. And I bet you do too, Ron.**

You sound like someone running for political office.

**If that matches their rhetoric, then maybe I should pay more attention to the candidates; I might want to back a few of them. The world is changing faster than we anticipated; we've all seen it. More than ever, we need leaders who not only comprehend the new threats facing us, but who will seriously and thoughtfully address them.**

You've been very vocal about that. About the new superhuman threat.

**Well I don't know where you got that term. I think to be a superhuman, one should begin by being, you know, from this planet.**

Bad choice of words?

**We should all be careful when we elevate anyone, human or alien, to "super" status.**

Because we're all equal.

**Well that's just absurd. No - I'm saying we need to be selective and elevate the right people. The right human people.**

And what are your thoughts on the Batman? He's human. Presumably.

**Well, he is. In fact, I'd say he's all too human. Any objective analyst will tell you that his brand of justice, vigilantism, is painfully outmoded, designed to be effective in an age when the law carried billy clubs because crime carried knives. The most dangerous guy on the street worked in the shadows because he was cowardly and superstitious. That's all you needed to play upon in order to disrupt their operations. You want to clean up the streets? Dress up like the boogeyman, switch on a fog machine and lower your voice.**

When you put it that way, it sounds ridiculous.

**It didn't when the Batman first appeared, but that was a long time ago. This is a new world, Ron, and it's time to get serious.**

(How serious?
Continued online at www.wired.com/partners/lexluthor)

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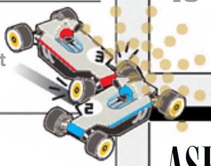

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«Le Zik, c'est chic !»
Nile Rodgers

Wireless, touch-controlled, and compatible with your Smartphone or Smartwatch, Zik 3 combines best-in-class sound technology and design by Philippe Starck. The headphones are designed to eliminate outside noise and engineered to enhance your music using sound spatialization. Zik 3 now charges wirelessly and stands out with its premium Crocodile-leather styles. Nile Rodgers, acclaimed guitarist and exceptional composer, has tested and approved Zik 3 in the legendary "Electric Lady" studio in New York.

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## BRIGHT IDEAS FOR 2016

Wander around WIRED's San Francisco headquarters on any given day and you're likely to encounter quite a zoo: hoverboard-riding video shooters dodging begoggled editors who are testing beta VR hardware; one of our favorite TV makers coming in for a meeting; security writers debating the latest cyberwar skirmish around the corner from a conference call with the founder of the Valley's latest unicorn company; and dogs (10 of them, by my count).¶ But this time of year, the always lively view from my desk takes on an especially electric feel as we train our focus on a new horizon. So to give you a sense of what we're gearing up to cover in 2016, I tapped the hive mind of writers and editors and pulled together a list of the big developments we expect to be following as the year unfolds. There's a lot to look forward to.

### Social media decides who becomes president

Politics is all about message control, but Twitter, Facebook, Snapchat, Vine, et al. have rewritten the messaging playbook. Today a random viral post can affect a candidate's chances as much as a seasoned political operative can. (Of course, the operatives are now on social media too.) How the pols grapple with this new reality will determine who takes the White House.

### Consumer-grade VR (finally!) arrives

Oculus Rift, the Samsung Gear VR, and the HTC Vive will be fighting it out in Q1, with PlayStation VR following later in 2016. Touted for years, these devices are finally getting real, and they're going to reshape entertainment—from game design to movies—with 2016 being a "let's see what sticks" time of experimentation.

### The cloud-connected smart home takes shape

More products from Google's Nest group and Apple HomeKit are rolling out, and voice control (Apple TV with Siri, Google Now, Amazon's Alexa, Cortana in Windows 10) is starting to work. In fact, the smart home is real enough already that attention is shifting to security. Breaches of the Internet of Things became a big problem in 2015 and will only get worse.

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NUMBER OF ALL-ELECTRIC CAR MODELS EXPECTED TO BE ON THE MARKET BY THE END OF 2016

### Autonomous driving gets serious

Cars (most notably from Tesla) can already handle routine driving and maintain a safe speed. We won't be handing over the steering wheel this year, but we will begin the prep work: talking about regulations, figuring out the best ways to apply the technology, and testing how humans interact with these vehicles.

### Electric cars break out

In the next year, Chevy will roll out the 200-mile, $30,000 Bolt. Tesla will show the Model 3, expected in 2017. Aston Martin, Bentley, Rolls-Royce, and Lamborghini are likely to tout plug-in hybrids. Not all of these cars will succeed or even come to market, but they'll all provide glimpses of how this technology will be adopted and how the infrastructure needs to evolve.

### The unicorn era draws to a close

All signs point to a day—or a year—of reckoning for tech "startups" valued at over $1 billion. Investors will soon expect to see real returns, and public markets may begin to lose patience.

### Designers move beyond mobile

We consume more content and do more things on our smartphones than ever before. So why does Google's VP of design, Matias Duarte, say mobile is dead? Because he recognizes that if today's designers want to be user-focused, they can't concentrate on just the mobile experience—or the desktop/car console/tablet/smartwatch experience. They need to think about how people move across all their devices through space and time.

OLIVER MUNDAY

### Designers aim at the next billion

The growth of connectivity in the emerging world poses some unique challenges to designers, who will be tasked with shaping user experiences not just for different devices but for different cultures, customs, and traditions. In 2016, WIRED will highlight the people and organizations designing with the next billion Internet users in mind.

### Artificial intelligence comes to the everyday

The days when AI was an arcane field of theoretical research are far behind us. Google uses AI to recognize photos, compose email replies, and refine search results. At Facebook it predicts what we'll find most interesting in our feeds. In 2016, with Google's TensorFlow now open-sourced, we'll be looking to see what upstarts can do with these powerful tools.

### Not to mention ...

Climate and the changing planet; cyberwarfare and terrorism; exploration of this planet and the rest of the universe, with perhaps a dollop of humans versus robots; health and medicine, in terms of new efforts to understand and cure disease as well as emerging diseases that are becoming more of a threat; and metanarratives on the practice of science itself, which is in flux—how journalism and grants work, replicability, and racism and sexism in the lab.

It's going to be one helluva year. Buckle up!

SCOTT DADICH
Editor in Chief
@SDADICH

ILLUSTRATION BY STANLEY CHOW; PHOTOGRAPH: JUSTIN SULLIVAN/GETTY IMAGES (CES)

## WIRED Long Reads

Need a story to curl up with? Check out our collection of engaging long reads. You'll find everything from Amy Wallace's 2009 piece about panicked parents skipping vaccines to Andy Greenberg's 2015 investigation of the effort to topple North Korea with American pop culture.

**ON THE WEB:** WIRED.com/tag/longreads

THE PLOT TO FREE NORTH KOREA WITH SMUGGLED EPISODES OF 'FRIENDS'

## CES 2016

Soon after the dust settles from New Year's, the consumer tech world heads to Las Vegas for CES. WIRED will be there, checking out all the new smart TVs, fridges, and cars, and maybe even a cool drone or 12. Tune in to WIRED.com for live coverage, and follow our team of reporters on the scene by subscribing to our handy Twitter list: twitter.com/WIRED/lists/ces2016

## The Next Five Decades of Football

Super Bowl 50 is around the corner, so WIRED and *Sports Illustrated* have teamed up to examine the future of football.

**ON THE WEB:** WIRED.com/sb100

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ARGUMENT

# A NEW NEW DEAL

## GIG-ECONOMY WORKERS NEED PROTECTION. NOW.

BY JESSI HEMPEL

**IN THE US,** we lump workers into two categories, employee or independent contractor, neither of which were designed for Fasil Teka. Teka, 41, joined Uber five years ago in Seattle. He drives roughly 40 hours a week as an independent contractor. He's also a party planner and sometimes shuttles guests for a local hotel. Teka loves the flexibility of having multiple gigs and driving only when he wants. When one income source wanes, another waxes. But the risks are mounting. He missed the 2014 deadline to sign up for Obamacare and had to do without health insurance. And last New Year's Eve his car got totaled, knocking him off of Uber for three weeks until he leased a new one. Most frustrating for Teka, Uber changes his fare rates frequently and with little warning. "Uber treats us as employees," Teka says—except, of course, with none of the benefits and protections of a traditional job, like the ability to negotiate fare prices through union

SR. GARCIA

representation or collect unemployment if Uber drops him.

A growing number of people like Teka are turning to software platforms to find flexible work. Five years after Uber launched, it now supports 400,000 drivers. That's a tiny number compared with the total 157 million workers in the US. But these kinds of companies are popping up across every industry, from housecleaning (Handy) to short-term rentals (Airbnb) to drafting legal contracts (UpCounsel). The gig economy is a bellwether for a broader shift to an Internet-powered workforce. "Vast sectors of our economy could change quickly," says Michelle Miller, who cofounded the worker advocacy platform Coworker.org. "You could imagine that 25 years from now, whole industries are managed on a software platform."

**IN SHORT**, work is changing; the protections we offer workers must change as well. And while some of that change is being hashed out in the courts as workers file lawsuits seeking to be reclassified as employees, it's not enough to help the US economy prepare for the future. Regardless of how these suits are resolved, they still group workers into categories designed for a 20th-century workforce, in which most people spent their careers employed by one large company. Increasingly, work doesn't work that way. We need smart regulation that will define new categories for workers—or at least offer better protection within existing categories. It's as critical to startups, which need to ensure a healthy labor supply, as it is to people like Teka.

In Seattle, the city council has proposed legislation that would allow drivers like Teka to bargain collectively. Independent contractors are not covered by the federal National Labor Relations Act, which enables employees to negotiate directly with companies. However, there is precedent for states to let them organize. "Farmworkers in California are not employees and couldn't legally be represented, but the state passed a law so they could be covered," says Teamsters organizer Dawn Gearhart, who is leading the Seattle effort—the first of its kind in the country to target gig-economy workers. While Uber would likely sue if the reform is passed, legal experts believe there's a good chance the courts would let the law stand, providing a model for the rest of the country.

> "A GROWING NUMBER OF PEOPLE ARE TURNING TO SOFTWARE PLATFORMS TO FIND FLEXIBLE WORK."

Some, including US senator Mark Warner (D-Virginia), have suggested piloting an "hour bank," a program used in construction to administer benefits like health care and disability for members who work for multiple contractors. However, gig-economy companies have so far shied away from any moves that could be construed as providing traditional benefits to contractors out of fear they will be sued.

Other reformers hold up the Affordable Care Act, which provides independent workers with a path to decently priced health care, as a model for other types of benefits. The ACA has resulted in a surge in the number of insured. (According to MBO Partners, which provides back-office support for independent contractors, a survey of those professionals showed that 82 percent had health care in 2015, up from 64 percent in 2013.) Indeed, Teka says he will sign up this year.

Meanwhile, some legal experts advocate a third regulatory category for workers in which they'd be responsible for some costs (like, say, making payments into a workers' compensation fund) but not others (like health care contributions). "An intermediate category could be part of the solution," says New York University law professor Cynthia Estlund. In Canada, for example, some individuals who rely only on a single employer are called dependent contractors. They can be eligible for reasonable notice of termination or compensation to make up for it.

None of these suggestions is the solution on its own, but together they represent the most forward-thinking approaches to ensuring the next century's workers and businesses are protected. Eighty years ago, the New Deal was intended to establish economic security for both, giving rise to the American middle class. We must act quickly and thoughtfully to create our century's version of this legislation, for the future of Teka—and Uber. ▣

**Jessi Hempel** (@jessiwrites) *is senior staff writer at* WIRED.

PROMOTION

SB 100

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**IN THE HEART OF SILICON VALLEY,** at the most connected stadium in the world, the Big Game will capture the attention of consumers across the globe. The editors of Sports Illustrated and WIRED have partnered to look 50 years into the future and explore America's greatest annual game through the lens of technology.

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ALPHA GEEK

# SURF'S UP (MAYBE) THE WAVE FORECASTER WHO CALLS MAVERICKS

**MARK SPONSLER** is surrounded by eight computers as he studies a spinning pink blob over the North Pacific on one of the screens. He's looking for a storm—one big enough to send a massive swell barreling toward the California coast. Ideally, that swell will slam into an underwater ridge a half mile off Pillar Point, creating waves 60 feet high. And a handful of lunatics will descend on Northern California to surf them. ¶ The founder of Stormsurf.com, Sponsler is responsible for collecting the data needed to green-light the Titans of Mavericks big-wave competition held between November and March at the notorious break. The contest doesn't happen every year; waves must be more than 40 feet high and surfable—as in, not exploding with Poseidon's rage. That's where Sponsler comes in. ¶ A former software engineer for NASA's shuttle program—and a big-wave surfer himself—the 58-year-old has been designing computerized wave models since the early days of the Internet. But he says that for important events like this, he crunches the numbers by hand using swell-decay tables—charts that estimate the rate at which swells steadily lose power as they travel through the ocean—and his own algebraic equations. Then he confirms his forecasts via the Jason-2 satellite, which can measure sea height to within about an inch. ¶ After 20 years of forecasting (and surfing) Mavericks, Sponsler says he can paddle out right before the sweet spot of a swell and "taste it like fine wine. You learn to pick out the very best barrel in a batch of a whole year's harvest." ¶ This year's El Niño (it's actually a "super El Niño") is almost guaranteed to produce a number of qualifying swells, Sponsler says, but that's no reason to stop running the numbers: "There's nothing worse than sitting here, it's contest morning, looking at all the data, going, 'Where's my friggin' swell?' " he says. "That's my nightmare." Our nightmare? Riding a 40-foot wave. —DAN STEINER

JAKE STANGEL

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# THE X-FILES FACTOR WRITERS WHO REDEFINED TV

**THE 1993 SHOW *THE X-FILES*** created our modern television landscape, with its dense story arcs and gory forensic police procedural elements. Many of the sci-fi drama's writers went on to develop or produce their own highly influential shows. Now, series creator Chris Carter is overseeing a new *X-Files* miniseries, and several former scribes have also signed on. "I tried to put the band back together," Carter says. WIRED took a look at the impact of several *X-Files* writers. —LEXI PANDELL

👽 = Working on new *X-Files*

**Vince Gilligan**
**Episodes: 30**
One was "Drive," costarring Bryan Cranston. "I thought, 'This guy is so good, I have to work with him again,'" Gilligan says. "Chris would say that we want episodes to look like miniature movies. I took that to heart."
**Went on to:** *Breaking Bad, Better Call Saul*

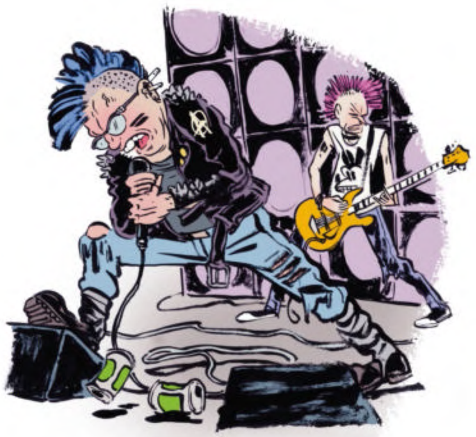
**Howard Gordon & Alex Gansa**
**Episodes: 20 (Gordon) and 6 (Gansa)**
They cowrote "Conduit," which filled in Fox Mulder's backstory. "I learned suspense on *X-Files* and leveraged that on *24*," Gordon says. "The audience felt like they had been on a roller coaster."
**Went on to:** *24, Homeland*

**James Wong 👽 & Glen Morgan 👽**
**Episodes: 15 each**
They cowrote "Beyond the Sea," a role-reversal episode. "Internet newsgroups were mad that [Dana] Scully was a disbeliever every week," Wong says.
**Went on to:** *American Horror Story* (Wong), *The River* (Morgan)

**Darin Morgan 👽**
**Episodes: 5**
His quirky script for "Clyde Bruckman's Final Repose," about a psychic who can foresee how people will die, won a writing Emmy. "Darin wrote several of the most beloved *X-Files* episodes—the comedy episodes," Carter says.
**Went on to:** *Fringe, Intruders*

**David Amann**
**Episodes: 7**
He wrote the teens-with-superpowers episode, "Rush." "One of the hardest things to write was when Scully and Mulder show up after the teaser, and we had to try to land 20 different ideas," he says.
**Went on to:** *Without a Trace, Castle*

MASSIMO DALL'OGLIO



# VIVE LA PUNK!

Martin Scorsese vexes me, and not just because he refuses to read my script for *Raging Bull 2: Jake LaMotta Goes Gymkata*. I'm livid because his upcoming HBO series, *Vinyl*, is an incorrect portrayal of the origins of punk rock. (To be fair, Scorsese is one of several executive producers, but I blame him for this—he's Johnny Effing Rotten compared to Mick Jagger and Terence Winter!) The show centers on a hedonistic music producer in 1970s New York who discovers a band that's a hybrid of Iggy Pop and the New York Dolls. So far, so good; I have a fondness for any group that played its first show in a homeless shelter. My own band, the Voight-Kampff Testes, maintains an unsolicited residency at the Hartford Airport Panda Express. RAWK! But here's the real problem: *Vinyl* treats this ersatz band as punk pioneers, when the roots of the movement in fact go *far* deeper. Has no one involved with *Vinyl* read Greil Marcus' book *Lipstick Traces*? The true roots of punk trace back to a 1950s European philosophical movement. If HBO wants to get real, then *Vinyl* needs to be about Parisian intellectual Guy Debord breaking off from the Lettrist arts movement and penning the manifesto that established the Situationist International! Think of the cinematic potential, HBO: genteel conversations in Gauloises-fogged cafés, feverish screed-writing montages. It's not just TV, it's *French history*. Ratings gold! Just send that honorary Emmy to the Panda—I've got rehearsal tonight.

PHOTOGRAPHS: ALAMY (*AMERICAN HORROR STORY, BREAKING BAD, WITHOUT A TRACE, HOMELAND*), SMALLZ AND RASKIND/FOX (*FRINGE*), GREG WILLIAMS/FOX (*24*), ABC/RICHARD CARTWRIGHT (*CASTLE*); ILLUSTRATION BY ZOHAR LAZAR

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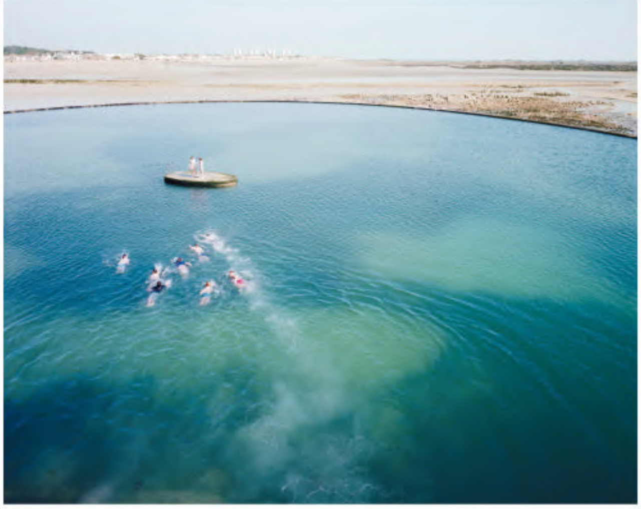
A popular tourist destination, the Cayman Islands are also synonymous with the notion of offshore financial activity. High-end leisure options abound here too, like a water-based jetpack ride. “The jetpack is zero gravity, the Caymans are zero taxes. We’re in the right place!” former owner Mike Thalasinos says.

Formerly a sanctuary for pirates, the Cayman Islands today have more registered companies than citizens and are the sixth-largest financial center in the world. Financial services there account for more than half of the country’s GDP. Yet many of the companies don’t even have an office—just an address.

Panama City recently faced a real-estate bubble that many observers agree was fueled by drug money from Colombia and Venezuela being laundered through property—apartment units that remain largely uninhabited. Panama has fiercely resisted transparency initiatives that have seen some success elsewhere.



Children swimming in Jersey, one of the Channel Islands off the UK coast. Jersey falls within a British network of secrecy jurisdictions, including places like the Caymans, Bermuda, and the City of London, that all have permissive financial laws. In aggregate, this network is the most important tax haven in the world.

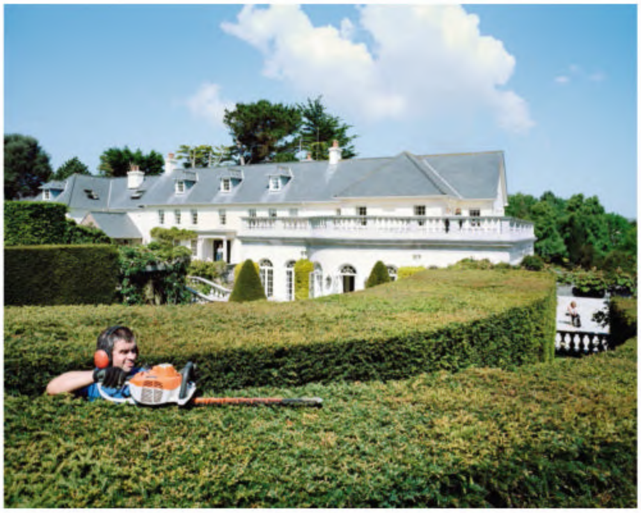
# SHELL GAME

## INSIDE THE WORLD’S TAX HAVENS

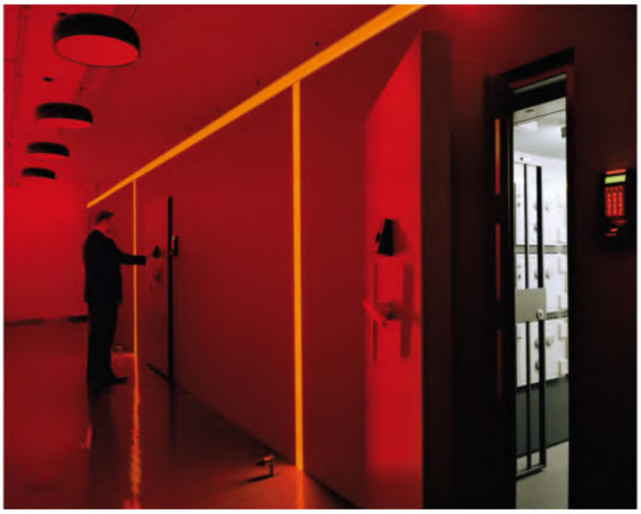
**THE ACCOUNTING INDUSTRY** has a Snowden, and his name is Antoine Deltour. In November 2014, the Luxembourg-based former PricewaterhouseCoopers employee leaked thousands of documents to mass media outlets around the world, revealing hundreds of tax-avoidance schemes exploited by more than 350 multinational corporations—and implicating the country’s long-standing status as a tax haven. ¶ As big as the “LuxLeaks” scandal was, it was limited to Luxembourg. In fact there are a dozen other tax havens—sorry, tax-neutral jurisdictions—that form an interconnected global web of secretive financial activity. At their core, tax havens serve those who wish to avoid the legal and regulatory scrutiny

INSTITUTE

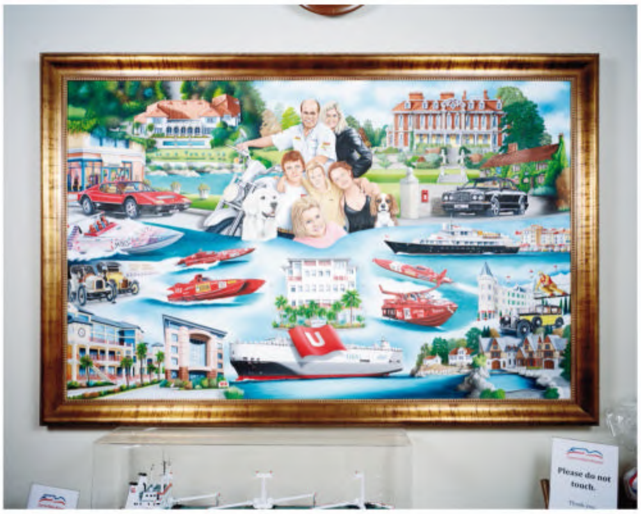
PAOLO WOODS & GABRIELE GALIMBERTI



Jersey provides incentives for high-income individuals to become residents, who thereby benefit from the island's very low taxes. Jersey is ranked 16th on the 2015 Financial Secrecy Index compiled by the Tax Justice Network; this represents a rare improvement in transparency over the past few years.

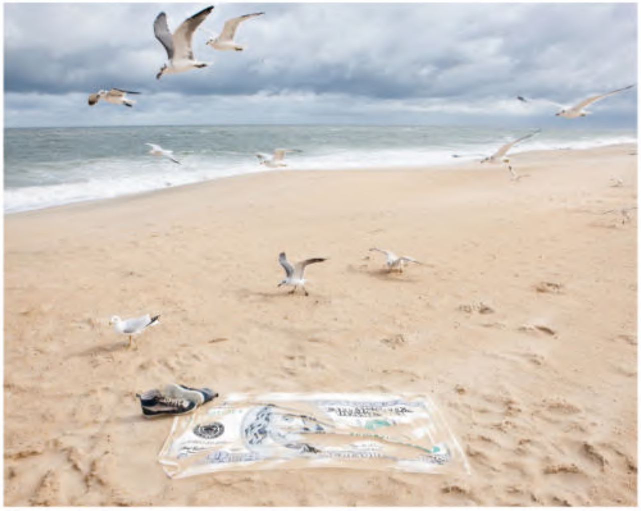


One of the most secure places on earth, the vault at Le Freeport Singapore includes biometric-recognition and vibration-detection technology. Located adjacent to the airport, Le Freeport contains untold billions in gold, cash, and other assets—even fine art for auction house Christie's—all stored in secrecy.



Please do not touch.

Don't be distracted by the garish depictions of boats and mansions in this painting of Caymanian billionaire Andreas Ugland. Over 19,000 companies are registered at the drab Ugland House there in the center. President Obama has said, "Either this is the largest building in the world or the biggest tax scam on record."



A $100 bill towel at Delaware's Rehoboth Beach. The US accounts for one-fifth of the global market for offshore financial services, and Delaware has particularly opaque disclosure laws that make it cheap and easy to incorporate a shell company to hide your identity and financial transactions.

(and tax burden) of their home countries. They enable companies to channel massive sums of money around the world, using byzantine structures of shell companies and sheltered accounts. They boast the latest in financial technology, like Internet banking and cloud computing services tailored for the online gambling industry. It's impossible to know how much wealth is stashed in secrecy jurisdictions (as their critics call them), but estimates range from $7.6 trillion to $32 trillion. (The GDP of the US is only about $17 trillion.) ¶ Photographers Paolo Woods and Gabriele Galimberti have spent the past three years gaining access to this secretive world, and for much of that time they labored over how to visually represent something that is often invisible by design. The images they collected in their book, *The Heavens*, are remarkable for what they reveal but are even more evocative because of what we know lies beneath the surface. "The consequences of these operations," Woods says, "are enormous and affect us all, from higher taxes to a less competitive market, from growing inequality to financial crises." The calm and ordered beauty of these photos belie the global reach, unimaginable wealth, and complex machinations that link them together. —NEIL HARRIS

## Q:

# WHEN MY 5-YEAR-OLD ASKS A QUESTION, IS THERE A DIFFERENCE BETWEEN LOOKING IT UP IN A BOOK AND JUST USING MY PHONE?

BY JON MOOALLEM

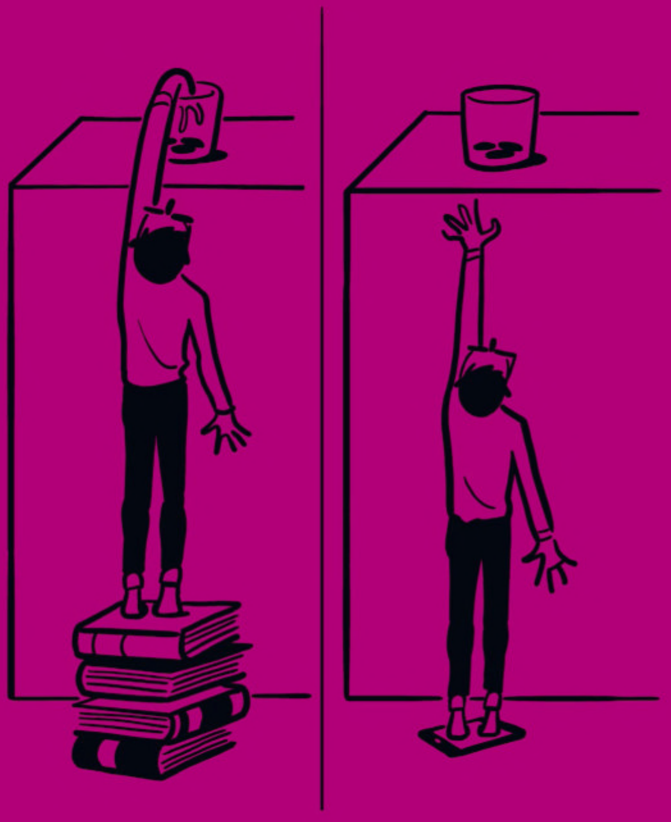
**A:** Recently, I watched David Kwong do some sleight of hand in a crowded theater lobby. Kwong is a magician who often consults on Hollywood films. (When a director needs, say, Jesse Eisenberg to learn a magic trick, they send him to Kwong.) Anyway, Kwong sauntered over to a guy with a deck of cards and asked him to pick one. ¶ Honestly, I don't know how to describe what happened next. For 30 minutes, Kwong made cards materialize in outrageous, stupefying ways, as though he were nonchalantly sliding them in and out of a parallel universe. Someone's card flew out of the deck, spinning through the air. Another turned up in a guy's back pocket—and not just *in* his back pocket, but buried deep, between his wallet and a bundle of crumpled receipts. Kwong asked someone to rip a card into four pieces, then hold them in his fist; when he opened his hand, the card was *reassembled*!

Maybe this doesn't sound that impressive, written down. We all know card tricks are a thing. But the way Kwong kept relentlessly confronting us with the impossible—seeing this sorcery at close range—seemed to not just entertain people but to make them feel vulnerable and a little scared. People mewled and screamed, "No!" One poor man was reduced to crouching on the floor, laughing so euphorically he couldn't catch his breath. (OK, that was me.) The guy with the ripped-up card in his fist refused to open it at first, shaking his head like a child terrified to look at his boo-boo, afraid of what he'd find. "He has total power over us," one woman said quietly, gravely. She sounded creeped out. It was so much fun!

Now, I'm sure everyone in that crowd wondered how Kwong was doing it, but it's a rare bird who goes home and actually labors to understand the mechanics of how such tricks are engineered. (Those rare birds become magicians—it's how Kwong got his start.) Most of us perceive magic tricks to be unreplicable, to violate the reality we inhabit. They're, you know, magic.

To a 5-year-old, phones are magic. The Internet is magic. An older kid might be able to understand the technology and infrastructure involved, the nature of Wikipedia, and so on, but for a child so young, the answer just appears, miraculously, like a playing card yanked from a bystander's back pocket. Leafing through a book together, by comparison, is a more collaborative, tactile, self-evident process. It's a journey *toward* the answer, one that your child gets to go on.

What I'm talking about is the difference between learning and being told, between answering a specific question and getting a child excited about answering it on their own. It's fun to amaze your 5-year-old, sure. But it's more gratifying to set your kid up to one day amaze you. ▣



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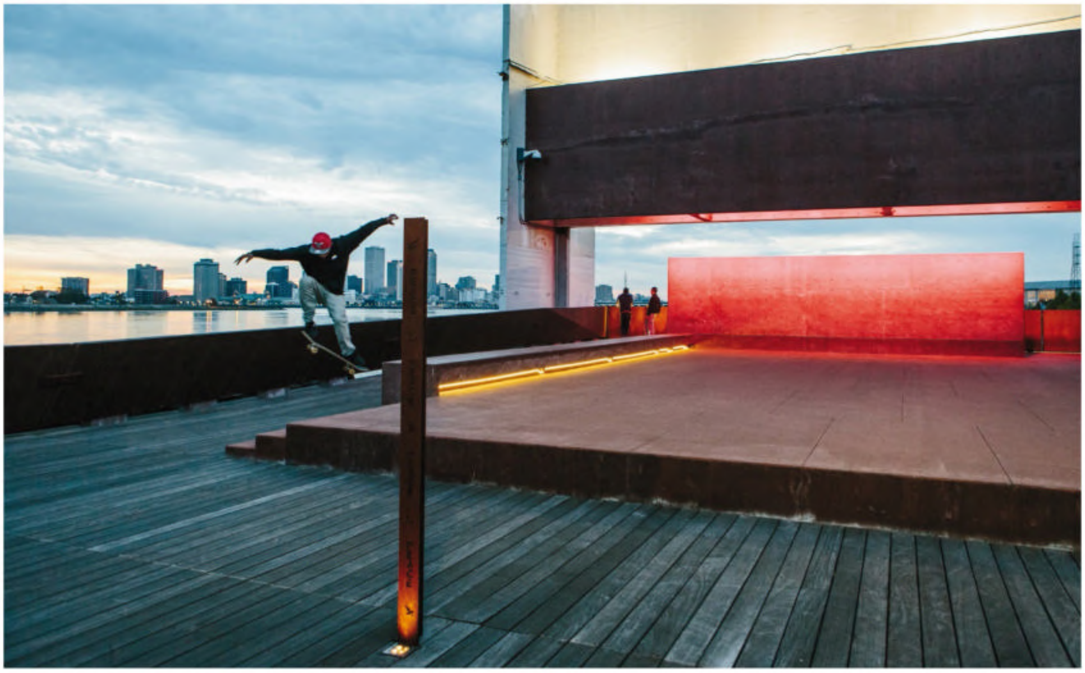
WIRED CITIES

# MORE THAN MARDI GRAS

## RUN TO NEW ORLEANS



The new Crescent Park features LED-lit public spaces where abandoned railroad tracks used to be.

**MARDI GRAS**—like New Orleans itself—encompasses more than you expect. Case in point: the Rouge-Orleans race. While many revelers stay up for 48 hours during the city's huge party, competitors in this 126.2-mile ultramarathon do it while running. The race starts in Baton Rouge on the Friday before Fat Tuesday and follows the Mississippi River levee to arrive in town Sunday. Challenges include fatigue (duh), running parallel to the old and supposedly haunted Carville leper colony (ooohhh), and possible wildlife (gators live in swamps). "Want to go to Mardi Gras?" Rouge-Orleans founder Denver Benton says. "Well come on, just run there." And here's what to do when you arrive. —NATHAN MATTISE

**"Tuesday night, go to the Maple Leaf to see the Rebirth Brass Band. They're Grammy winners now, but they still play this tiny little bar. It's something crazy, but it's a regular thing every Tuesday."**

—Melissa Weber, aka DJ Soul Sister, host of an acclaimed rare-groove show on WWOZ

### See

The **Backstreet Cultural Museum** boasts an entire room of hand-sewn Mardi Gras Indian suits; each is made of thousands of feathers and can weigh more than 70 pounds. Check out the state-of-the-art (for 1933, anyway) bar gear at the **Museum of the American Cocktail**. Constructed after Hurricane Katrina, the **Inner Harbor Navigation Canal Lake Borgne Surge Barrier** is a 2-mile-long, 26-foot-high barrier of steel and concrete that will (hopefully) do a heckuva job protecting the city from 100-year storms.

### Do

Hip hop icons like Mannie Fresh and Mystikal explain how local rap, bounce, and brass interconnect in the **NOLA Hip Hop and Bounce Archive** at Tulane University. Let it goooo, $H_2$OOOOOO: **Thinkerella** is a mobile science lab that holds workshops inspired by the movie *Frozen*. Budding scientists make polymer turn into snow and test Newton's third law with jumping Olafs. Tour **St. Louis Cemetery No. 1** to learn about the aboveground, citylike burial system and to see Nicolas Cage's presumably empty, pyramid-shaped tomb.

### Eat

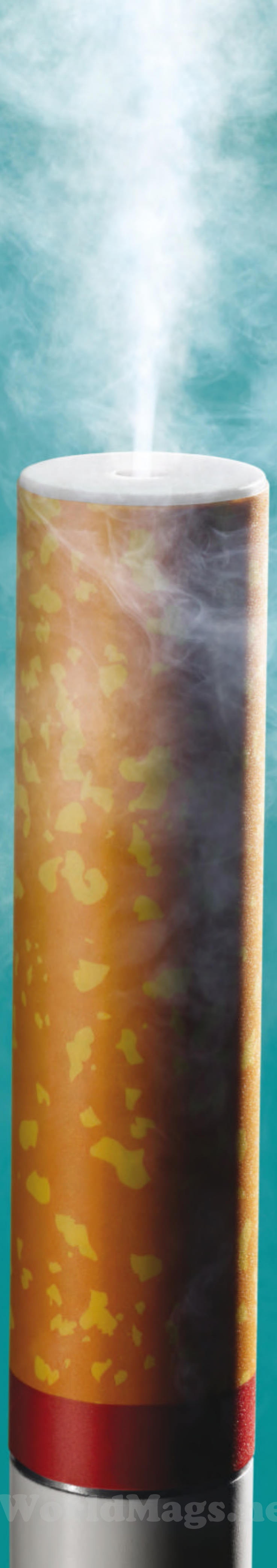
Jeff "Beachbum" Berry travels the globe to uncover historical cocktail recipes and re-creates them at his bar, **Latitude 29**. The fried chicken recipe at **Willie Mae's Scotch House** hasn't changed since 1957; today the restaurant serves up to 500 pounds of it daily. Red beans and rice are everywhere. You can get Vietnamese iced coffee most places. But only **District Donuts** packs such flavors into *mmmmm* … doughnuts.

ILLUSTRATIONS BY KRISTIAN HAMMERSTAD; SKYLINE BY MUTI

WILLIAM WIDMER

WHAT'S INSIDE

# E-CIG JUICE FORTIFIED WITH ANTIFREEZE AND UNICORN MILK!



THE VOORHES

**Water**

Many "vape juice" flavor formulations include good old $H_2O$. A reservoir for liquid and a heating element are the basic components of e-cigarette devices. A wicking material such as cotton pulls the liquid toward a metal coil, where heat turns it into droplets that are tiny enough to inhale.

**Vegetable Glycerin**

You've probably consumed this sugar alcohol in food as a low-glycemic sweetener, a preservative, or a texture enhancer that boosts thickness. (It's also an ingredient in skin moisturizers.) Many e-cig aficionados credit the syrupy vegetable glycerin for the pea soup density of the billowing clouds they exhale.

**Propylene Glycol**

A tasteless, odorless, colorless alcohol that's used in antifreeze solutions to lower the freezing temperature of water. While it's generally considered safe for topical use and consumption, it's also an active ingredient in many fog-machine juices, which can act as allergens and cause eye and airway irritation. It can also cause headaches, dizziness, and drowsiness.

**Nicotine**

E-cig juice can have as much or as little of this highly addictive chemical as the vaper wants. In its inhaled particulate form, nicotine itself is pretty safe—unless you're a kid, or a fetus gestating inside a vaper. But in liquid form, even tiny amounts that are ingested or make contact with skin can induce vomiting, seizures, and even death. Wear gloves when you refill your vape tank.

**Flavoring**

The names of e-cig flavor formulations are amazing: Unicorn Milk, Krispy Krack Doughnut, Pony on Acid! But the contents are an utter mystery. Manufacturers generally don't reveal the ingredients, on the grounds that they're "trade secrets." Many are quick to assert that their flavorings are food-grade and recognized as safe by the FDA. But that's in terms of eating—the health effects of *inhaling* such flavorings aren't currently known. Puff? Pass.

—BLANCA MYERS

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# FUEL FOR THOUGHT

EACH DAY, THIS FERRY MAKES TENS OF TRIPS BETWEEN TWO SMALL PORTS ON NORWAY'S WEST COAST. IN MANY WAYS IT'S AN UNREMARKABLE VESSEL. AND YET MASTRAFJORD IS POWERED BY A REMARKABLE FUEL – LNG

**On a cool and misty western Norwegian** morning, Captain Harry Mellingen-Haugland (main image) eases Mastrafjord around the sea wall and slowly brings the ferry into dock. Despite its size, the 130m vessel appears agile and is surprisingly quiet, doing little to disrupt the calm waters of Boknafjord. From the ferry's bridge, Mellingen-Haugland has a 360-degree view of the stretch of water he crosses tens of time a day.

Named after another nearby fjord, Mastrafjord shuttles between the tiny ports of Mortavika and Arsvågen. The 11km crossing takes around 20 minutes, with up to three ferries in operation at any time. Millions of people make the journey, which helps link the picturesque west coast cities of Stavanger and Bergen, every year.

"It's the second busiest ferry route in Norway – in terms of vehicles and pedestrians," says Mellingen-Haugland, surveying the view from his captain's chair. "In the winter months it's mostly people who live and work in the area, and heavy transport. But during summer time it's very much people on holiday in the fjords."

Efforts have been made in the area to use liquefied natural gas (LNG) as a fuel instead of diesel. Mastrafjord, and its sister ships Stavangerfjord and Boknafjord were designed to run on LNG, to reduce sulphur emissions, particulates and nitrogen oxides.

So, what is this fuel? LNG is a clear, colorless, non-toxic liquid, which forms when natural gas – mostly methane, with other alkanes, including ethane and propane, and carbon dioxide – is cooled to -162°C. This process shrinks the volume of the gas by 600 times, making it easier to store and transport to markets around the world – either by pipeline, truck or shipping.

Using LNG can reduce sulphur emissions – as it gives off virtually zero sulphur emissions, particulates and nitrogen oxides. It has other benefits too.

# "FOR US, WORKING AND OPERATING LNG ENGINES, IT IS VERY CLEAN COMPARED TO OTHER LIQUID FUELS."

"For those of us working and operating LNG engines, it is very clean compared to other liquid fuels," says Peringe Rundhoude, chief engineer on Mastrafjord. "Inside the engine – inside the crankcase – it looks brand new when you open it. When you pull out pistons and cylinder liners for overhauling, you see the equipment is within new tolerances. Even with 50,000 hours wear."

From his workstation just below the captain's bridge, Rundhoude oversees a strict maintenance schedule on-board Mastrafjord, with spark cables, coils and pilot wells requiring refitting regularly. However, he can thank the work of Jeanine Klinkenbijl for the as-new appearance of his ferry's inner workings. As principal technical expert for fuel processing at Shell, Klinkenbijl oversees the processes that result in hydrocarbons, such as natural gas, being at their optimum potential for use.

"There are a few drivers to what I do – such as safety and efficiency," she says. "If there are sulphur deposits, we can remove them and turn them into elemental sulphur for asphalt or fertilizer. If you have $CO_2$, it can be used for enhanced oil and gas recovery, or to store it using carbon capture and storage."

But Norwegian passenger ferries like Mastrafjord, Stavangerfjord and Boknafjord aren't the only vehicles that are powered by LNG.

In 2013, Shell launched the first 100 percent LNG-powered tank barge. Greenstream – managed by the Dutch based Interstream Barging – and its sister ship Green Rhine, are in service on the Rhine. Today Shell Shipping & Maritime manages 44 LNG carriers – around 11 percent of the world's LNG fleet – making Shell one of the largest LNG carrier operators.

Elsewhere, LNG is being used in the heavy trucking industry. In October 2015, Shell opened its fourth LNG truck refuelling station in the Netherlands. The station in Amsterdam is located in the western port area, a location with significant turnover from ships to trucks that distribute goods into the city.

"This business is emerging and it's early days," says Thomas Chhoa, who leads business efforts on LNG in transport at Shell. "We are committed to LNG as a fuel option, but it will take time to develop this market. Certainly in Shell we are investing in both the marine, and heavy-duty road transport sector to provide customers with this cost-competitive and cleaner burning* fuel."

The three ferries of Mortavika-Arsvågen are certainly doing their bit. Since 2007 Stavangerfjord and Mastrafjord (Boknafjord launched in 2011) have each made up to 41 journeys a day, linking Norway's third-largest city with the country's tourist hotspot.

In the winter months it's dark when the ferries set out in the morning, and night will have fallen long before they make the final journey of the day. But these boats will continue to make their short, regular voyages, helping to keep families connected, businesses running and travellers moving forward to the next part of their Nordic adventures. ***For more, search #makethefuture***

PHOTOGRAPHY: CHRISTOFFER RUDQUIST

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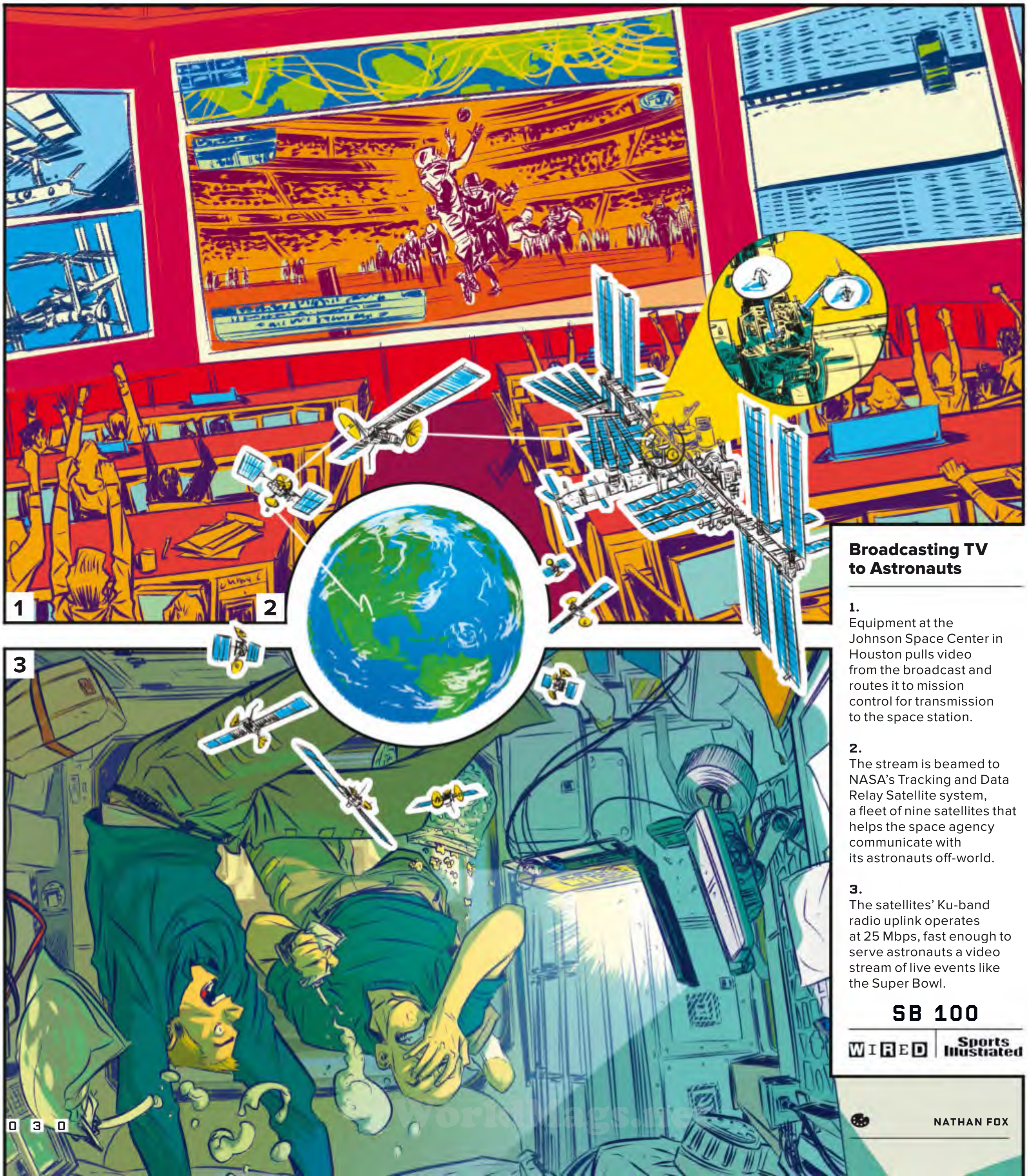
*COMPARED TO DIESEL AND HEAVY FUEL OIL

# SUPER BOWL IN SPACE

## TOUCHDOWN ON THE ISS

**LAST FEBRUARY,** more than 114 million viewers tuned in to Super Bowl XLIX, making it the most-watched television program of all time in the US. Among that audience: the crew of the International Space Station. ¶ Kickoff was at 6:30 pm eastern time, but the ISS circles Earth about 16 times in a 24-hour period, obliterating any traditional sense of day and night. Astronauts stick with Greenwich mean time, putting the game's start at a much less reasonable 11:30 pm. ¶ Watching movies and TV shows in space isn't novel; in fact, the ISS was recently outfitted with an HD projector and specially designed 65-inch screen. But the content arrives in a tremendously expensive, and painfully infrequent, way. On DVD. On a rocket ship. ¶ "Every crew can request and have delivered a contemporary collection of DVDs for their viewing enjoyment," says NASA spokesperson Stephanie Schierholz. "TV and films, along with books and music, are important aspects of psychological support for astronauts on long-duration missions." ¶ But watching a live broadcast is something else entirely. Here's how astronauts are able to see the big game in near real time. —BRIAN BARRETT



### Broadcasting TV to Astronauts

1. Equipment at the Johnson Space Center in Houston pulls video from the broadcast and routes it to mission control for transmission to the space station.

2. The stream is beamed to NASA's Tracking and Data Relay Satellite system, a fleet of nine satellites that helps the space agency communicate with its astronauts off-world.

3. The satellites' Ku-band radio uplink operates at 25 Mbps, fast enough to serve astronauts a video stream of live events like the Super Bowl.

SB 100

NATHAN FOX

IN THE FUTURE, THE WAY FANS WATCH THE GAME WILL CHANGE. BUT THE WAY ATHLETES FUEL IS ALREADY CHANGING.

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WHY PAUSE?

You shouldn't have to interrupt a spontaneous moment to take a pill. Or stop to find a bathroom. Only CIALIS for daily use (5 mg) treats both ED and the frustrating symptoms of BPH, like needing to go frequently, day or night.

**Don't forget to take this CIALIS $200 Savings Card* to your healthcare provider. For more information, go to cialis.com.**

*Terms and conditions apply.

cialis.com/**ED**and**BPH**

**Ask your healthcare provider about CIALIS for daily use**, approved to treat men with erectile dysfunction, or ED (2.5 mg, 5 mg), and both ED and the signs and symptoms of benign prostatic hyperplasia, or BPH (5 mg). Taking CIALIS with finasteride when starting BPH treatment has been studied for 26 weeks. CIALIS is not for women or children. **Do not take CIALIS more than one time each day.**

Cialis®
(tadalafil) tablets

## What Is The Most Important Information I Should Know About CIALIS?

**Do not take CIALIS if you:**

- **take medicines called "nitrates"** such as isosorbide dinitrate or isosorbide mononitrate, which are often prescribed for chest pain as the combination may cause an unsafe drop in blood pressure; or use recreational drugs called "poppers" like amyl nitrite and butyl nitrite
- **are allergic to CIALIS or ADCIRCA® (tadalafil), or any of its ingredients.** Call your healthcare provider or get help right away if you experience any symptoms of an allergic reaction, such as **rash, hives,** swelling of the lips, tongue or throat, or difficulty breathing or swallowing

**After taking a single tablet, some of the active ingredient of CIALIS remains in your body for more than 2 days.** The active ingredient can remain longer if you have problems with your kidneys or liver, or you are taking certain other medications.

Stop sexual activity and get medical help right away if you get symptoms such as chest pain, dizziness, or nausea during sex. Sexual activity can put an extra strain on your heart, especially if it is already weak from a heart attack or heart disease.

## What Should I Tell My Healthcare Provider Before Taking CIALIS?

**CIALIS is not right for everyone. Only your healthcare provider and you can decide if CIALIS is right for you.** Ask your healthcare provider if your heart is healthy enough for you to have sexual activity. Do not take CIALIS if your healthcare provider has told you not to have sexual activity because of your health problems. Before taking CIALIS, tell your healthcare provider about all your medical problems, particularly if you have or ever had:

- **heart problems** such as chest pain (angina), heart failure, irregular heartbeats, or heart attack
- **uncontrolled high or low blood pressure**
- **stroke**
- **liver or kidney problems or require dialysis**
- **retinitis pigmentosa,** a rare genetic (runs in families) eye disease
- **severe vision loss, including a condition called NAION**
- **stomach ulcers or a bleeding problem**
- **a deformed penis shape** or Peyronie's disease
- **an erection that lasted more than 4 hours**
- **blood cell problems** such as sickle cell anemia, multiple myeloma, or leukemia

## Can Other Medicines Affect CIALIS?

Tell your healthcare provider about all the medicines you take, especially:

- medicines called "nitrates" which are often prescribed for chest pain
- alpha-blockers often prescribed for prostate problems
- blood pressure medications
- medicines for HIV or some types of oral antifungal medications
- some types of antibiotics such as clarithromycin, telithromycin, erythromycin (several brand names exist, please contact your healthcare provider to determine if you are taking this medicine)
- other medicines or treatments for erectile dysfunction (ED)
- CIALIS is also marketed as ADCIRCA for the treatment of pulmonary arterial hypertension. Do not take both CIALIS and ADCIRCA. Do not take sildenafil citrate (Revatio®)* with CIALIS.

## What Should I Avoid While Taking CIALIS?

- Do not use other ED medicines or ED treatments.
- Do not drink too much alcohol (for example, 5 glasses of wine or 5 shots of whiskey). Drinking too much alcohol can increase your chances of getting a headache or getting dizzy, increasing your heart rate, or lowering your blood pressure.

## What Are The Possible Side Effects Of CIALIS?

**The most common side effects with CIALIS are:** headache, indigestion, back pain, muscle aches, flushing, and stuffy or runny nose. These side effects usually go away after a few hours. Men who get back pain and muscle aches usually get it 12 to 24 hours after taking CIALIS. Back pain and muscle aches usually go away within 2 days. Call your healthcare provider if you get any side effect that bothers you or one that does not go away.

**Uncommon but serious side effects include:**
An erection that won't go away: If you get an erection lasting more than 4 hours, seek immediate medical help to avoid long-term injury.

In rare instances, men taking prescription ED tablets, including CIALIS, reported a sudden decrease or loss of vision or hearing (sometimes with ringing in the ears and dizziness). It's not possible to determine if these events are related directly to the ED tablets or to other factors. If you have a sudden decrease or loss of vision or hearing, stop taking any ED tablet, including CIALIS and call a healthcare provider right away.

**You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch or call 1-800-FDA-1088.**

## CIALIS does not:

Cure ED, increase a man's sexual desire, protect a man or his partner from sexually transmitted diseases, including HIV or serve as a male form of birth control.

**CIALIS is available by prescription only. For additional information, talk to your healthcare provider and see the brief summary of patient information on the next pages.**

**The brand listed is a trademark of its respective owner and is not a trademark of Eli Lilly and Company. The maker of this brand is not affiliated with and does not endorse Eli Lilly and Company or its products.*

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Lilly

# Important Information for Patients
# CIALIS (see-AL-iss)
## (tadalafil) tablets

**Read this important information before you start taking CIALIS and each time you get a refill. There may be new information. You may also find it helpful to share this information with your partner. This information does not take the place of talking with your healthcare provider. You and your healthcare provider should talk about CIALIS when you start taking it and at regular checkups. If you do not understand the information, or have questions, talk with your healthcare provider or pharmacist.**

### *What Is the Most Important Information I Should Know About CIALIS?*

- **Do not take CIALIS if you take medicines containing nitrates or recreational drugs (like amyl nitrite or butyl nitrite "poppers")**, as the combination may cause a sudden unsafe drop in blood pressure. You could get dizzy, faint, or have a heart attack or stroke. Nitrates are found in many prescription medicines commonly used to treat chest pain such as nitroglycerin, isosorbide dinitrate, or isosorbide mononitrate.
- Tell all of your healthcare providers that you take CIALIS. If you need emergency medical care for a heart problem, it is important for your healthcare provider to know when you last took CIALIS.
- **After taking a single tablet, some of the active ingredient of CIALIS remains in your body for more than 2 days.** The active ingredient can remain longer if you have problems with your kidneys or liver, or you are taking certain other medications.
- If you get symptoms such as chest pain, dizziness, or nausea during sex when taking CIALIS, stop sexual activity and get medical help right away.

### *What Is CIALIS?*

CIALIS is a prescription medicine taken by mouth for the treatment of:

- men with erectile dysfunction (ED)
- men with symptoms of benign prostatic hyperplasia (BPH)
- men with both ED and BPH
- If CIALIS is used with finasteride to initiate BPH treatment, such use is recommended for up to 26 weeks.

**CIALIS for the Treatment of ED**

ED is a condition where the penis does not fill with enough blood for a man to get or keep an erection. CIALIS helps increase blood flow to the penis and may help men with ED get and keep an erection satisfactory for sexual activity. Once a man has completed sexual activity, blood flow to his penis decreases, and his erection goes away. Some form of sexual stimulation is needed for an erection to happen with CIALIS.

**CIALIS does not:**

- cure ED or increase a man's sexual desire
- protect a man or his partner from sexually transmitted diseases, including HIV
- serve as a male form of birth control

CIALIS is only for men over the age of 18, including men with diabetes or who have undergone prostatectomy.

**CIALIS for the Treatment of Symptoms of BPH**

BPH is a condition that happens in men, where the prostate gland enlarges which can cause urinary symptoms.

**CIALIS for the Treatment of ED and Symptoms of BPH**

ED and symptoms of BPH may happen in the same person at the same time. Men with both ED and symptoms of BPH may take CIALIS for the treatment of both conditions.

CIALIS is not for women or children.
**CIALIS must be used only under a healthcare provider's care.**

### *Who Should Not Take CIALIS?*

**Do not take CIALIS if you:**

- **take any medicines called nitrates or use recreational drugs called "poppers" such as amyl nitrite and butyl nitrite**
- **are allergic to CIALIS or ADCIRCA® (tadalafil) or any of its ingredients.** Call your healthcare provider or get help right away if you experience any symptoms of an allergic reaction, such as **rash**, **hives**, swelling of the lips, tongue or throat, or difficulty breathing or swallowing

### *What Should I Tell My Healthcare Provider Before Taking CIALIS?*

**CIALIS is not right for everyone. Only your healthcare provider and you can decide if CIALIS is right for you.** Before taking CIALIS, tell your healthcare provider about all your medical problems, including if you have or ever had:

- **heart problems** such as chest pain, heart failure, irregular heartbeats, heart attack, or stroke. Do not take CIALIS if your healthcare provider has told you not to have sexual activity because of your health problems.
- **uncontrolled high or low blood pressure**
- **liver or kidney problems or require dialysis**
- **retinitis pigmentosa,** a rare genetic eye disease
- **severe vision loss, or a condition called NAION**
- **stomach ulcers or a bleeding problem**
- **deformed penis shape** or Peyronie's disease
- **an erection that lasted more than 4 hours**
- **blood cell problems** such as sickle cell anemia, multiple myeloma, or leukemia

### *Can Other Medicines Affect CIALIS?*

CIALIS and other medicines may affect each other. Always check with your healthcare provider before starting or stopping any medicines. Tell your healthcare provider about all the medicines you take including prescription and non-prescription medicines, especially:

- medicines called nitrates
- medicines called alpha-blockers, sometimes prescribed for prostate problems or high blood pressure. If CIALIS is taken with certain alpha-blockers, your blood pressure could suddenly drop. You could get dizzy or faint.
- other medicines to treat high blood pressure (hypertension)
- medicines called HIV protease inhibitors
- some types of oral antifungals
- some types of antibiotics such as clarithromycin, telithromycin, erythromycin (several brand names exist, please consult your healthcare provider to determine if you are taking this medicine)
- other medicines or treatments for ED
- CIALIS is also marketed as ADCIRCA for the treatment of pulmonary arterial hypertension. Do not take both CIALIS and ADCIRCA. Do not take sildenafil citrate (Revatio®)* with CIALIS.

### *How Should I Take CIALIS?*

Take CIALIS exactly as your healthcare provider prescribes it. He or she will prescribe the dose that is right for you and may adjust your dose, depending on how your body reacts to CIALIS. Some men can only take a low dose of CIALIS or may have to take it less often, because of medical conditions or medicines they take. CIALIS may be taken with or without meals.

**For symptoms of BPH, CIALIS is taken once daily.**

- Take 1 CIALIS tablet every day at about the same time of day.
- If you miss a dose, take it when you remember, but **do not take CIALIS more than once each day.**
- **When therapy for BPH is initiated with CIALIS and finasteride, the recommended dose of CIALIS once daily use is taken at approximately the same time every day for up to 26 weeks.**

**For ED, there are 2 ways to take CIALIS – either for use as needed OR for use once daily.**

**CIALIS for use as needed:**

- **Do not take CIALIS more than once each day.**
- Take 1 CIALIS tablet before you expect to have sexual activity.

**OR**

**CIALIS for once daily use is a lower dose you take every day:**

- Take 1 CIALIS tablet every day at about the same time of day. You may attempt sexual activity any time between doses.
- If you miss a dose, take it when you remember, but **do not take CIALIS more than once each day.**

**For both ED and symptoms of BPH, CIALIS is taken once daily.**

- Take 1 CIALIS tablet every day at about the same time of day. You may attempt sexual activity any time between doses.
- If you miss a dose, take it when you remember, but **do not take CIALIS more than once each day.**

***What Should I Avoid While Taking CIALIS?***

- Do not use other ED medicines or ED treatments.
- Do not drink too much alcohol (for example, 5 glasses of wine or 5 shots of whiskey), as it can increase your chances of getting a headache or getting dizzy, increasing your heart rate, or lowering your blood pressure.

***What Are the Possible Side Effects of CIALIS?***

**The most common side effects with CIALIS** are headache, indigestion, back pain, muscle aches, flushing, and stuffy or runny nose. These side effects usually go away after a few hours.

Men who get back pain and muscle aches usually get them 12 to 24 hours after taking CIALIS. Back pain and muscle aches usually go away within 2 days.

**Uncommon side effects include:**

- Erection that won't go away. If you experience an erection lasting more than 4 hours, seek medical help right away to avoid permanent damage.
- Color vision changes, such as seeing a blue tinge or having difficulty telling the difference between the colors blue and green.
- The following events have been reported in men taking oral ED medicines, including CIALIS: (1) sudden decrease or loss of vision in one or both eyes; (2) sudden loss or decrease in hearing, sometimes with ringing in the ears and dizziness. It is not possible to determine whether these events are related directly to the medicines, other health conditions, or to a combination of these. If you experience a sudden decrease or loss in vision or hearing, stop taking CIALIS and call a healthcare provider right away.

These are not all the possible side effects of CIALIS. For more information, ask your healthcare provider or pharmacist.

**You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.**

***Still have questions?***

This is only a summary of important information. Talk to your doctor or pharmacist for more complete information or visit www.cialis.com, or call 1-877-CIALIS1 (1-877-242-5471).

**The brand listed is a trademark of its respective owner and is not a trademark of Eli Lilly and Company. The maker of this brand is not affiliated with and does not endorse Eli Lilly and Company or its products.*

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**Indianapolis, IN 46285, USA**

Find additional information at www.cialis.com

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CIALIS (tadalafil) tablets, for oral use

PV 5227 AMP

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12/8 – 12/20

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After hosting a decade of holiday pop-up shops, this year WIRED will present an entirely different retail experience. Visitors have the opportunity to browse and play with a collection of WIRED-curated products in an interactive window, building their ultimate wish list.

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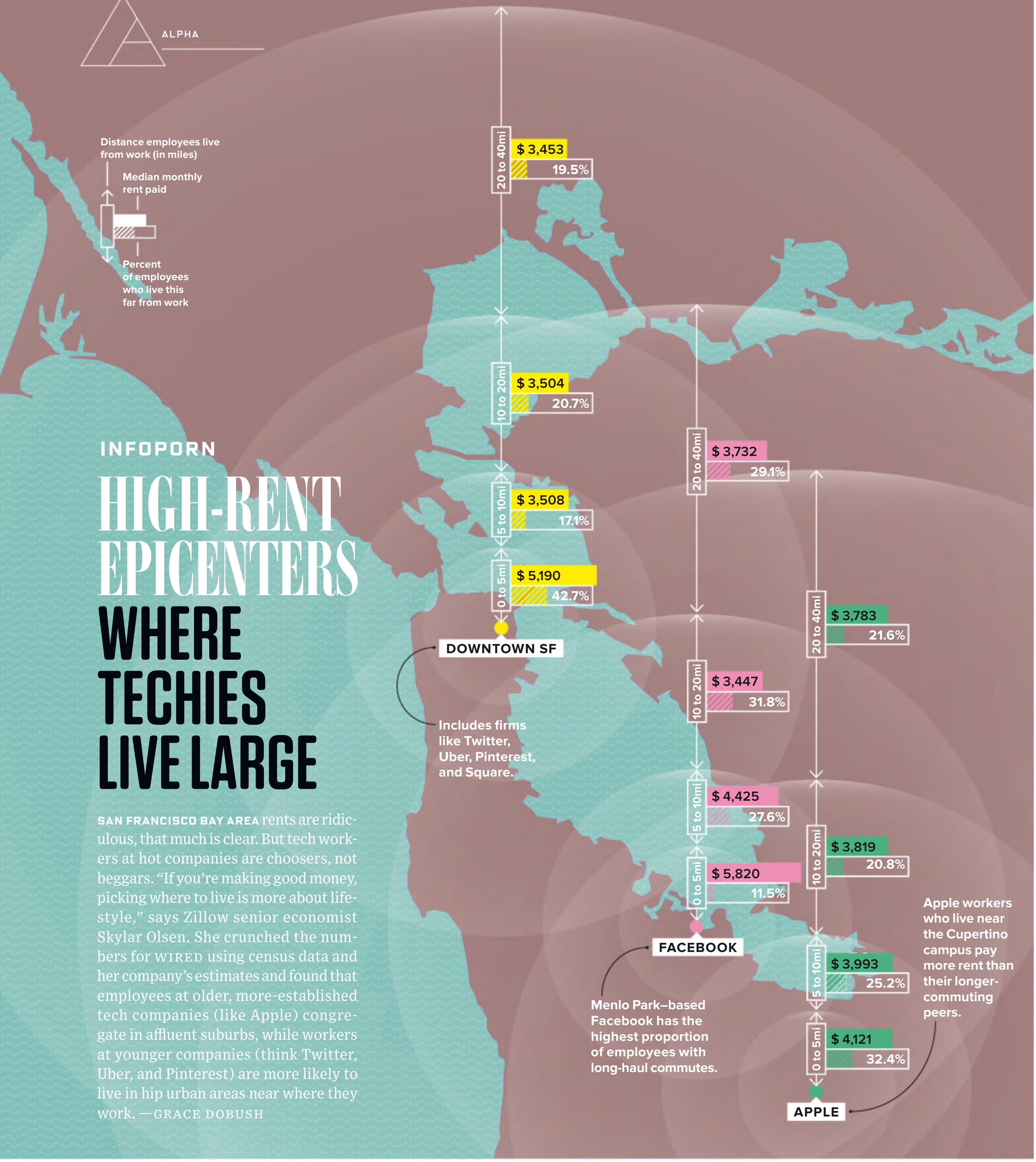
# HIGH-RENT EPICENTERS WHERE TECHIES LIVE LARGE



Includes firms like Twitter, Uber, Pinterest, and Square.

Menlo Park–based Facebook has the highest proportion of employees with long-haul commutes.

Apple workers who live near the Cupertino campus pay more rent than their longer-commuting peers.

**SAN FRANCISCO BAY AREA** rents are ridiculous, that much is clear. But tech workers at hot companies are choosers, not beggars. “If you’re making good money, picking where to live is more about lifestyle,” says Zillow senior economist Skylar Olsen. She crunched the numbers for WIRED using census data and her company’s estimates and found that employees at older, more-established tech companies (like Apple) congregate in affluent suburbs, while workers at younger companies (think Twitter, Uber, and Pinterest) are more likely to live in hip urban areas near where they work. —GRACE DOBUSH

ZILLOW DATA DRAWN FROM THE U.S. CENSUS’ LONGITUDINAL EMPLOYER-HOUSEHOLD DYNAMICS SURVEY.

## JARGON WATCH (POCKET EDITION)

**megasupramolecules** *n. pl.* / ˌme-gə-ˈsü-prə-ˌmä-li-kyülz / Fuel additives that can prevent explosions in crashes. These long-chain polymers stop fuel droplets from dispersing on impact. **social credit** *n.* / ˈsō-shəl ˈkre-dit / A personal trustworthiness rating, mandated by the Chinese government for implementation by 2020. **bitplain** *n.* / ˈbit-ˌplān / A data storage format that preserves readability of photos and videos in perpetuity by recording all the bits encoding each pixel. **micro pig** *n.* / ˈmī-krō ˈpig / A genetically modified pig designed to grow no larger than a midsize dog. Initially created to fit in cramped medical labs, micro pigs will soon be sold in China as house pets. —JONATHON KEATS

MAKES
CYBER
CRIMINALS
CRY

PC
Mac
Mobile

CNET Editor's Rating
★★★★½
Outstanding

500 M
DOWNLOADS

5B+ MALWARE
REMOVALS

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INSTALLED*

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Malwarebytes

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# ASTEROID RAGE

## SPACE MINING COULD SET OFF A STAR WAR

**SPACE IS LOUSY** with profits. Consider the asteroid Ryugu: It's made of so many tons of nickel, iron, cobalt, and water, it's worth an estimated $95 billion. Venture into deeper space and there's even richer plunder—like Davida, an asteroid that the wanna-be space mining company Planetary Resources values at more than $100 trillion. That's more than five times the GDP of the US. ¶ These jaw-dropping payloads are why extraterrestrial mining is becoming an increasingly serious endeavor. Companies like Planetary Resources, backed by the likes of Googlers Larry Page and Eric Schmidt, are already launching satellites to scan for the most promising asteroids. Space experts say some firm could be ready to launch a mission within 10 years. But are they allowed to? Of course, anyone can *reach* an asteroid—NASA already has. But can you *own* one? ¶ Let's start with existing space law. The big one on the books is the 1967 Outer Space Treaty. Ratified by 103 countries, including the spacefaring ones, it prohibits anyone from "appropriating" territory in space. (There's an even more restrictive 1979 Moon Treaty as well, but the spacegoing countries haven't signed, so it's probably less relevant.) The upshot, most space-law scholars agree, is that nobody can claim a celestial body for their own. ¶ But what about just extracting resources and bringing them home? The issue hasn't been litigated, but extraction is probably legally OK. Indeed, there's precedent: The US brought 842 pounds of rocks back from the moon, and they're designated as property of the US. No other country has disputed that ownership; in fact, the US and USSR traded moon rocks and regolith. "Russia has even sold some commercially," says James Dunstan, a space-law expert with the Mobius Legal Group.

The big wrinkle may not be whether it's legal to mine an asteroid but how to figure out who has permission and who owns what claims. The US has no agency or process to issue licenses for space mining. "The politics can't be known, but there will be politics," says Joanne Gabrynowicz, a space-law expert at the University of Mississippi. Licenses give clarity not only to would-be miners but also to investors and governments starting their own operations. "If you don't have that license, the investors are taking a big chance," she says.

The US is now drawing up a law. Problem is, it's unilateral and incomplete. The Commercial Space Launch Competitiveness Act of 2015 says citizens can "possess, own, transport, use, and sell" an asteroid resource once they obtain it. But the bill doesn't establish an agency or process for issuing licenses. Worse, it says your ownership claim begins as soon as you *detect* the existence of metals on an asteroid. You don't even have to plant a flag. But what if China and Russia have different ideas—and different laws for their own citizens? Commercial activity in distant space could easily cause seething international strife here on our home planet.

Luckily, there are precedents for working together. When satellites became big business in the 1960s, the major industrialized countries decided to use a multistate body—the International Telecommunication Union—to approve the orbits. It's almost like domain-name registration. Fully 193 countries abide by these rules. Something similar could work for asteroid mining: an international body with local laws written in sync. Or, says Dunstan, countries could adopt bilateral agreements to recognize each other's legislation and then build treaties.

There's a chance the spacefaring nations could get this right. I hope they do. Otherwise it'll be *Star Wars* for real—with trillions in nickel and cobalt in the balance.

*Email* clive@clivethompson.net.

ZOHAR LAZAR

ADVERTISEMENT

# RADIO DOT SYSTEM

## HOW THE CHIEF DISRUPTOR IMPROVED HIS OFFICE DATA SPEEDS FIVE-FOLD

The CHIEF DISRUPTOR is the forward-thinking exec that didn't just write the book on the future, he made it happen. His vision impacts the way we live (or will live).

**IT'S ONE OF THOSE GREAT IRONIES:** You work for a tech company but at the office, your own technology barely functions because the cellular connection is deplorable. And with 70 percent of mobile traffic generated indoors, forward-thinking brands and CEOs are adopting a solution to this poor connectivity.

Like our very own Chief Disruptor. He and his CTO recently integrated Ericsson's new Radio Dot system into their office's network to put his company—and his employees—back on the fast track to productivity.

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● **WIRED Insider:** Why did you feel the need for a connectivity solution?

● **Chief Disruptor:** In the past few years, my company has grown from a start-up with only a few people to a mid-sized company with a couple hundred employees. We occupy two floors of an office building and mobile signals in big buildings can be atrocious. That's compounded by the fact that we're in a green, Energy Star building. While I love the eco-friendly nature of our office (that's part of why we chose it), the insulated windows, UV protection, and reinforced structure actually impede cellular signals even more than traditional buildings do. I realized we had to find a solution.

● **WIRED Insider:** What attracted you to Ericsson Radio Dot?

● **CD:** The other options out there required a large chunk of space within our office for the cables and radio units, and would take hundreds of hours to install. Plus, they would require additional investment every time we needed to scale up.

Even on first impression, I could tell the Radio Dot was different than everything else I'd seen. For one, each cell is a small and sleek radio broadcaster—basically, they are smaller than a smoke detector. The compact base station connects to our carrier cell signal, and then distributes the signal to the Dots, which are connected and powered by standard Internet LAN cables. That meant we wouldn't have to make major infrastructure changes to set them up. I think the whole installation took something like a week for our entire building.

● **WIRED Insider:** How has the Radio Dot improved connectivity within your office?

● **CD:** The changes to our connectivity have been like night and day. My CTO tells me that our data speeds are five times faster than before we installed it. We'd all gotten so used to dropped connections that we didn't realize just how bad it had gotten until we fixed it.

● **WIRED Insider:** What would you say is the most beneficial aspect of the technology to your business?

● **CD:** It's probably the seamlessness of it all. Hardly anyone has an assigned desk in our space—including me. We're constantly moving around, taking calls, and pulling up shared data on tablets and laptops in every corner of the office—often while having a conversation or loading a presentation. Dead zones in the building used to, well, kill us. Now, because of the integrated cellular and WiFi, no matter where we are in the office, our connection stays the same and it's uninterrupted as we go in and out of the building.

● **WIRED Insider:** How has the installation impacted your employees?

● **CD:** The vibe in the office has definitely changed. There are fewer stress-fueled office moments where people want to go ballistic on their hardware. It's actually improved people's moods. Not only is using the network far less frustrating for them, but its actually saved them time. And that's the one intangible employee benefit people want more of than anything else.

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# FETISH
# SWEET CHARIOT

**BUILDING A HIGH-END** racing bike has traditionally been an exercise in compromise. Aerodynamic models slice through the wind with their flattened frame tubes, but they're stiff and ponderous to pilot. Lightweight climbing bikes sail over the Galibier, but they have inferior aerodynamics and can flex too much when you're mashing the pedals. Trek's Madone model eliminates these trade-offs, fusing a sleek design with the comfort of a springier ride. Airfoil-shaped tubes and inside-the-frame cable routing reduce air friction, and the tube-within-a-tube seat post design decouples the saddle from the frame, dampening vibrations. The result is a speed freak with a warm soul—like an F1 car with a cushy suspension and plush seats. —**MARK MCCLUSKY**

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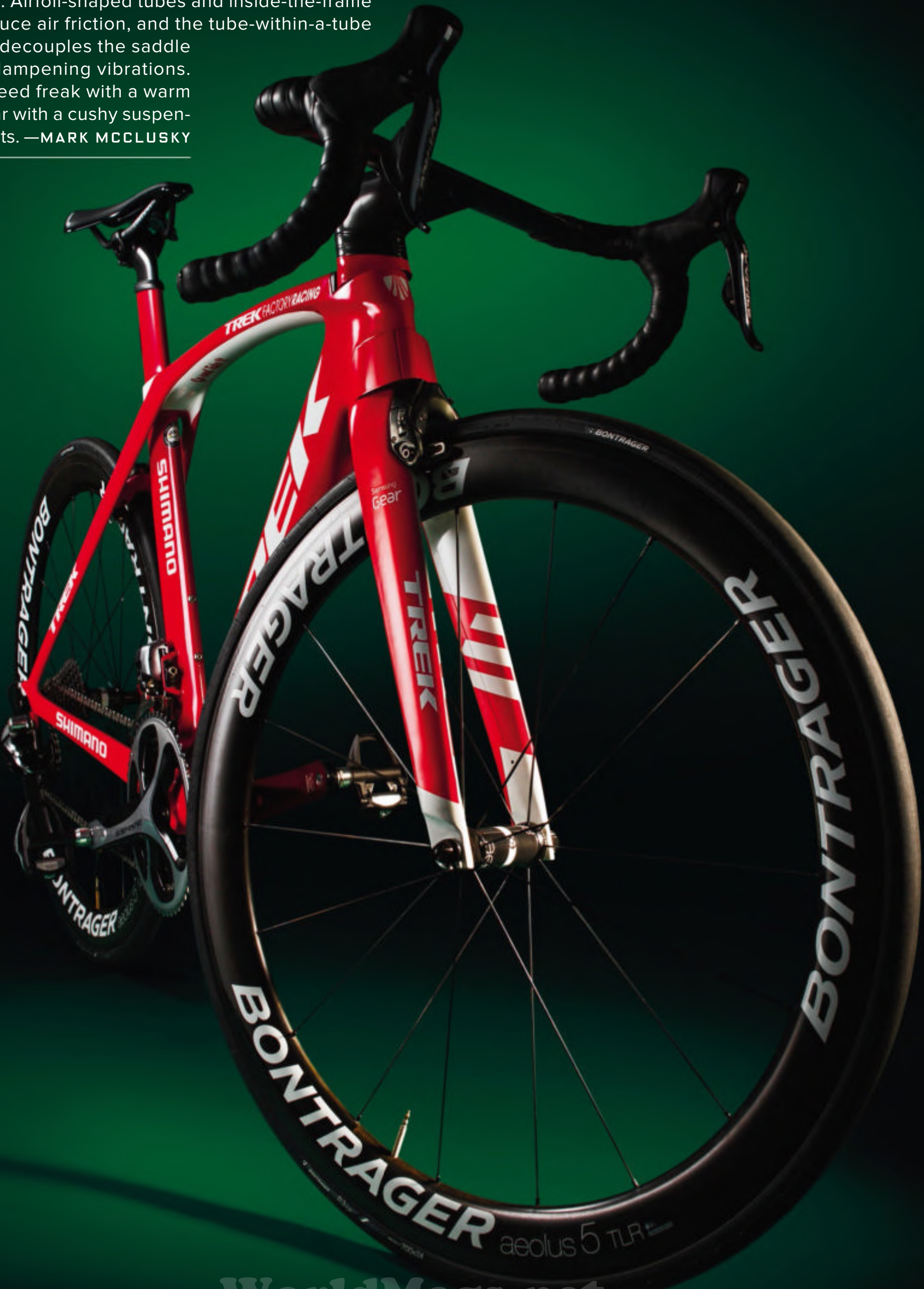
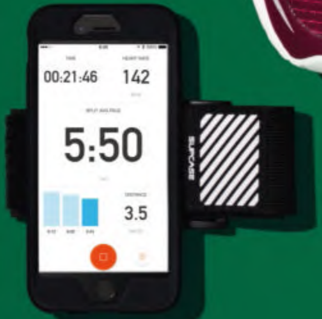


JOSEPH SHIN

# GEARHEAD

# GO THE DISTANCE

Who needs a gym membership? Your two best training partners are attached to your ankles. —GORDON GOTTSEGEN



1

**Nike Aeroloft Flash Vest**

This vest might be featherlight, but it offers heavy-duty warmth. The 800-fill down provides superior insulation, while tiny perforations enhance breathability. When it's time to shed the extra layer, the whole thing stuffs into its own back pocket.

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2

**Jaybird X2 Bluetooth Headphones**

Runners need buds that stay put. Jaybird's epic-sounding wireless earphones come with several different sizes of ear tips and fins, pretty much ensuring that you'll find a fit that locks into your lobes. The battery is tiny but lasts eight hours.

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3

**New Balance Vazee Pace Protect Pack**

Don't let the winter drizzles slow you down. The weather-resistant closed-mesh upper makes these running shoes ideal for even the poorest conditions. The design of the midsole won't alter your foot's natural movement, so it's best for runners with good form.

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4

**Supcase Easy Fitting Sport Case With Armband**

If you can't run without your phone, it's time to invest in a sport armband. This inexpensive number has a comfortable but grippy fit that stays put even when your skin gets slippery. A reflective patch helps you stand out better at night.

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5

**Rudy Project Proflow**

These superlight sunglasses have adjustable antislip nose-pads and temple tips, so they'll stay put no matter how much you *schvitz*. The lenses are changeable too; swap in a clear eye-shield for those nighttime wind sprints.

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**WHY IS AN** old-school machine like the WaterRower still popular? Don't credit its cameo in *House of Cards* as Frank Underwood's stent deterrent. That's strictly window dressing. The real draw is efficiency: Since its introduction almost three decades ago, nobody has invented a better cardio machine. It exercises 84 percent of body muscle mass, burns more than 1,000 calories an hour, calls for a full range of motion, and is low-impact. Thanks to hydrodynamic drag, it can also be a hellish workout. Doubling your rowing speed produces an eightfold increase in resistance. That's not just pain. That's exponential pain. The thing doesn't look bad, either. Propped up next to a sofa, it could pass for a Dada-esque sculpture. Your fancy digital treadmill can't keep pace with that. —**RENE CHUN**

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PHONE APP: COURTESY OF STRAVA

JOSEPH SHIN

# HEAD-TO-HEAD
# TWO FOR TEE

A PGA Tour pro can hit any driver perfectly. Everyone else needs a tool that matches their swing. —MARK MCCLUSKY

**Ping G30**

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**TaylorMade M1**

**BEST FOR: Swing tinkerers needing maximum adjustability**

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## IVY INNOVATOR TECH AWARDS

### Tech Mogul Justin Kan hosts 2nd annual IVY Innovator Tech Awards, presented by Cadillac

Internet entrepreneur Justin Kan, founder of Twitch.tv and Justin.tv, joined IVY to celebrate the winners and finalists of the 2015 IVY Innovator Tech Awards at the Exploratorium in San Francisco on September 30. The winner of the 2015 Tech Award was Jessica Richman, cofounder and CEO of uBiome, a startup that enables individuals to sequence and understand their own microbiomes. Jessica's life-changing work plays a pivotal role for the average citizen to take control over his or her own health. Other finalists included Shradha Agarwal, cofounder and president of Context Media; Amar Bakshi, founder of Shared Studios; Moawia Eldeeb, cofounder and CEO of SmartSpot; Timothy Hwang, founder and CEO of FiscalNote; and Arshya Vahabzadeh, director of Digital Health for Brain Power.

The IVY Innovator Awards, presented by Cadillac, identify individuals who are changing the world through their work in film, technology, and design. The winners and finalists of the program are passionate entrepreneurs and visionaries with a strong mission to make a positive impact on their community.

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JOE MCKENDRY

# THE NINE LIVES OF LEO DICAPRIO

BY
ROBERT
**CAPPS**

PHOTOGRAPHS
BY
DAN
**WINTERS**

# THE *REVENANT* STAR ON **SURVIVING** FAME, PARACHUTE MALFUNCTIONS, CLIMATE CHANGE, AND FILMING IN CANADA'S FROZEN TUNDRA.

ILLUSTRATIONS BY JOE **MCKENDRY**

Leonardo DiCaprio doesn't always survive. *Titanic*? Dead. *Django Unchained*? Unalive. *The Departed*? Departed. *Romeo and Juliet*? We won't spoil that one for you, but you get the point. His new movie, *The Revenant*, takes the struggle not to die and really, really goes with it. In the film DiCaprio plays Hugh Glass, a real-life 1820s fur trapper who got mauled by a bear, was robbed and abandoned by his companions, and then spent months crawling to safety through the untamed American wilderness. As for what it took to play the part of Glass, well, let's just say it involved a lot of snow, bearskins, and numb digits. The production of the film, directed by a fresh-off-*Birdman* Alejandro Iñárritu, was so complicated and geographically challenging that at times the moviemakers themselves needed to claw and scrape to keep it alive—filming had to be repeatedly stopped and resuscitated. But survive they all did (Glass, DiCaprio, and *The Revenant*), and the result will be coming to you in a safe, warm, dry theater on Christmas Day. We sat down with DiCaprio to ask him about endurance, his own brushes with death, and perhaps the biggest survival story of them all—how the hell we all might live through climate change. Spoiler alert: One of these things involves a shark.

**ROBERT CAPPS** (@robcapps), WIRED*'s head of editorial, wrote about scientists fighting Ebola in issue 23.05.*

**WIRED: Watching the opening of *The Revenant*, all I could think was, "That looks really cold."**

**DICAPRIO:** It was physically grueling for everybody. We had to have this massive crew go to far-off locations and move around all over the high altitudes, from Calgary to Vancouver. Like in *Birdman*, Alejandro Iñárritu created these very intricate shots with [director of photography Emmanuel] "Chivo" Lubezki, where he was weaving in and out of the forest. He would have the camera veer off to this expansive battle sequence, then come right back to another intimate moment with the character. They had coordinated all that stuff with a lot of precision. But of course when we got there, the elements sort of took over.

**What drew you to the role of Hugh Glass?**

Glass was a campfire legend—and it's all true. He survived a savage bear attack, was left for dead, then traveled through this uncharted territory of interior America, crawling through hundreds of miles of wilderness on his own. So to me the story was a simple linear story, but in Alejandro's hands, of course, it becomes a sort of visual, existential poetry. Not a lot of directors wanted to take this on because of how difficult it would be to shoot. The script had been floating around for a couple of years. It wasn't until Alejandro was attached to this man's struggle in nature that it got going. I reread it and met him again, and I decided to embark on what I would characterize as more of a chapter of my life than a film commitment—because it was epic in every sense of the word.

**So you're filming outside, it's cold, it's dirty, it's brutal. What was that like for you? Were there times when you asked yourself, "Why am I doing this?"**

Moments? Every single day of this movie was difficult. It was the most difficult film I've ever done. You'll see, when you see the film—the endurance that we all had to have is very much up on the screen.

**What was the worst part?**

The hardest thing for me was getting in and out of frozen rivers. [*Laughs.*] Because I had elk skin on and a bear fur that weighed about 100 pounds when it got wet. And every day it was a challenge not to get hypothermia.

**How prepared was the crew for that? Did they say, "Well, we're going to throw DiCaprio into a frozen river, we better have some EMTs here"?**

Oh, they had EMTs there. And they had this machine that they put together—it was kind of like a giant hair dryer with octopus tentacles—so I could heat my feet and fingers after every take, because they got locked up with the cold. So they were basically blasting me with an octopus hair dryer after every single take for nine months.

**And there were a lot of takes.**

Alejandro and Chivo had this vision to shoot in natural light. We had months of rehearsal beforehand, but every day was like doing a play. Each actor, each bit of the set, needed to be like gears in a Swiss watch, because the camera was moving around and you had to have your timing perfect. So we rehearsed every day, and then we had a two-hour window of natu-

PREVIOUS SPREAD: STYLING BY EVET SANCHEZ FOR THE WALL GROUP; ASSISTANT STYLING BY ALEXANDER PAUL; GROOMING BY SONIA LEE FOR EXCLUSIVE ARTISTS MANAGEMENT USING MATRIX STYLELINK; JACKET BY BRUNELLO CUCINELLI; JEANS BY BLK; SUNSEL T-SHIRT; SHOES BY FIORENTINI + BAKER; *THE REVENANT*: COURTESY TWENTIETH CENTURY FOX; FOLLOWING SPREAD: COCKPIT JACKET; T-SHIRT BY LEVI'S; PANTS BY BRUNELLO CUCINELLI; SWEATER BY MASSIMO ALBA

ral light to shoot. This movie is a little like virtual reality—it's the closest thing to being submerged in nature. In the bear attack, you can almost feel the breath of the bear. It's unlike anything you've ever seen.

**I heard you had problems with snow.**

We had a lot of complications while shooting, because it was the hottest year in recorded history. In Calgary there were all these extreme weather events. One day we were trying to do a scene and it turned out to be 40 below zero, so the gears of the camera didn't work. Then twice during the movie we had 7 feet of snow melt in a day—all of it, within five hours—and we were stuck with two or three weeks of no snow in a film that's all snow. So we had to shut down production multiple times. That's what happens with climate change; the weather is more extreme on both ends.

**You even had to wrap early and resume filming when you could find snow again, right?**

We had to go to the South Pole!

**That's crazy.**

We had to go to the southern tip of Argentina, to the southernmost town on the planet, to find snow.

**Do you have a lot of outdoor experience? Are you a survival school kind of a guy?**

I love being immersed in nature and wild places. I love scuba diving, and I've been up and down the Amazon. But as far as dropping me off with a small bit of rations? Before this movie I wouldn't have known the first thing about it.

**I heard that you've had a couple of brushes with death yourself, though.**

My friends have named me the person they least want to do extreme adventures with, because I always seem to be very close to being part of a disaster. If a cat has nine lives, I think I've used a few. I mean, there was the shark incident ...

Things Hugh Glass survived: Arikara warriors, freezing cold, a bear.

**Shark?**

A great white jumped into my cage when I was diving in South Africa. Half its body was in the cage, and it was snapping at me.

**How the hell did it get into the cage?**

They leave the tops open and you have a regulator line running to the surface. Then they chum the water with tuna. A wave came and the tuna sort of flipped up into the air. A shark jumped up and grabbed the tuna, and half its body landed inside the cage with me. I sort of fell down to the bottom and tried to lie flat. The great white took about five or six snaps an arm's length away from my head. The guys there said that has never happened in the 30 years they'd been doing it.

**Did the shark just get itself out and swim away?**

It flipped itself back out again. I have it on video. It's insane. Then there was this Delta Airlines flight to Russia. I was in business class, and an engine blew up in front of my eyes. It was right after "Sully" Sullenberger landed in the Hudson. I was sitting there looking out at the wing, and the entire wing exploded in a fireball. I was the only one looking out at the moment this giant turbine exploded like a comet. It was crazy. They shut all the engines off for a couple of minutes, so you're just sitting there gliding with absolutely no sound, and nobody in the plane was saying anything. It was a surreal experience. They started the engines back up, and we did an emergency landing at JFK.

**Jeez.**

The other one was the skydiving incident. It was a tandem dive. We pulled the first chute. That was knotted up. The gentleman I was with cut it free. We did another free fall for like another 5, 10 seconds. I didn't even think about the extra chute, so I thought we were just plummeting to our death. He pulled the second, and that was knotted up too. He just kept shaking it and shaking it in midair, as all my friends were, you know, what felt like half a mile above me, and I'm plummeting toward earth. [*Laughs.*] And he finally unravels it in midair. The fun part was when he said, "You're probably going to break your legs on the way down, because we're going too fast now." So after you see your whole life flash in front of your eyes—twice—he says, "Oh, your legs are going to get broken too."

"THE HARDEST THING WAS BEING IN **FROZEN RIVERS** WITHOUT GETTING HYPOTHERMIA."

**That didn't happen?**

No, we did, like, this barrel roll. We got bruised up, but no broken legs.

**Do you still skydive?**

No. No, I do not.

**This is sort of a meta question, but you've obviously spent pretty much your whole life in the public eye—how have you survived that?**

How have I survived it?

**A lot of people don't.**

You know, the truth is, it's very surreal. I don't think anyone really gets used to being recognized around the world. It kind of feels like a videogame at times, especially with paparazzi and people following you and things of that nature. But it's part of who I am now. It's part of my life as long as I choose to do what I do as a profession, and I love what I do. I think I survive because I don't limit myself. If there's some experience I want to have or a place I want to go, I do it. I think that's how I bring some semblance of normality to my life.

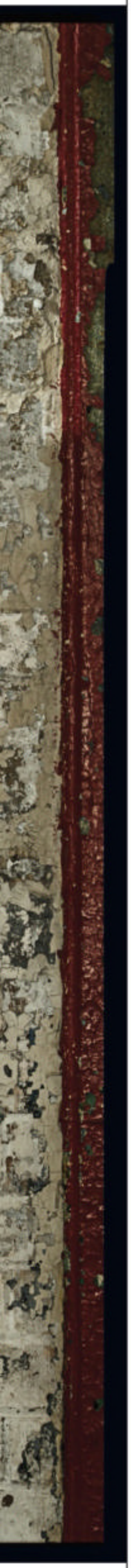
**We talked a little about the crazy weather patterns that affected your movie. Of course, any talk of survival has to include talk of climate change, and you are a vocal environmentalist. How did that start?**

So there was a period in my career, post-*Titanic,* where I took a break and I wanted to reevaluate the other great passion in my life—I've been interested in science and biodiversity ever since I was very young, probably from watching films about the rain forest at the Natural History Museum.

**That interested you as a kid?**

I'm not from the country. I lived in downtown LA, in the Silver Lake area, which is close to the Natural History Museum. So I got exposed to the wonders of nature through film—Imax documentaries and such. It was something I always loved, and after *Titanic* I decided to explore that interest by getting more involved in envi-

Things Leonardo DiCaprio has survived: a shark, a skydiving mishap, filming *The Revenant*, multiple supermodel attacks.



ronmental issues. I was lucky and got to have a meeting with Al Gore in the White House. He pulled out a chalkboard and drew planet Earth and drew our atmosphere around it. And he says, if you want to get involved in environmental issues, this is something not a lot of people are talking about—remember, this was 17, 18 years ago—but climate change is the single greatest threat to humanity that we've ever had. That put me on this path. We did Earth Day in 1999. I started a foundation. I started speaking out about the issue. And then, of course, Gore's film came out, and I think that affected everyone in a profound way.

**What do you see as the biggest challenges?**

We've seen such a tremendous lack of leadership, and we've allowed these trillion-dollar industries to manipulate the argument about the science for too long. This year is a massive tipping point in the climate struggle. As I said, it's the hottest year in recorded history. July was the hottest month in recorded history. We're seeing methane bubbling up from underneath the seafloor. There are massive heat waves, drought, fires going on; ocean acidification is happening on a massive scale. It's scary. I went to Greenland and there are rivers flowing like it's the middle of the Grand Canyon. The question is, what do we do to mitigate that? Are we going to come together as a world community? Are we going to evolve as a species and actually combat this issue? The human race has never done anything like that in the history of civilization.

**So it's a little bigger than just "Buy a hybrid car"?**

I once was talking to Naomi Klein, who to me is one of the most powerful voices in the climate movement. She wrote a book called *This Changes Everything*, and it's about capitalism versus the environment. And look, everyone loves money, I love money—we live in the United States. This is a capitalist country. But ultimately we've locked ourselves, through capitalism, into an addiction to oil that's incredibly hard to reverse. I'm making a documentary about this, and I asked Naomi to give me something I could say that would help people understand what they need to do. She told me there isn't one thing that an individual can do. That whole greenwashing movement, buying a hybrid (which of course can't hurt), recycling, this and that, it's not going to cut it. This needs to be a massive movement on a global scale. And it needs to happen now. This year, 2015, is going to be the year people look back on and say we either made the right choices or we didn't.

> "RECYCLING, DRIVING A HYBRID—THAT **GREENWASHING** STUFF JUST ISN'T GOING TO CUT IT."

**What do you feel is the role of technology in this crisis?**

Silicon Valley should be absolutely focused on this issue. Certainly Elon Musk is out there doing it—but the Facebooks, the Googles, all these organizations should be focused on global warming.

**Corporations, of course, are usually driven by economics.**

Everyone in Silicon Valley who is reading this: Look at Divest Invest. It's something I'm involved in, and it's a fantastic way you as an individual can say, "I do not want to have investments in oil, coal, or gas." The technology has caught up to a point where renewables are not going to be devastating to the economy. And actually there is tons of money to be made. This could be the biggest economic boom in American history if we do it right.

**Are you a fan of geoengineering—finding a scientific fix for climate change?**

There are scientists in London who talk about blasting chemicals into the atmosphere to make it more reflective. There are also people who want to put an iron sulfate mixture into the ocean to sequester enough carbon to reverse this trend. That's all great, but we need to create an insurance policy for ourselves right now. And that means we need to stop spewing out so much carbon. If we can figure out a way in the future to reverse the effect of greenhouse gases with geoengineering, all the better. But we can't depend solely on a technological miracle.

**Who should we be listening to?**

Look, not to get political, but listening to Bernie Sanders at that first presidential debate was pretty inspiring—to hear what he said about the environment. Who knows which candidate is going to become our next president, but we need to create a dialogue about it. I mean, when they asked each of the candidates what the most important issue facing our planet is, Bernie Sanders simply said climate change. To me that's inspiring.

**You got any tips for surviving an interview with a journalist?**

[*Laughs.*] Only talk about what you want to talk about, no matter what the question is. ▣

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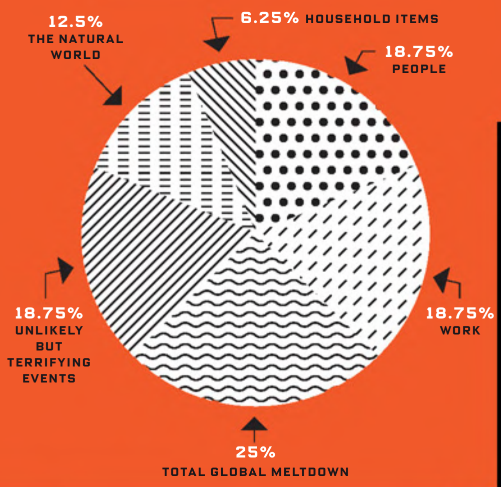

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# COUNTER A CAR HACK

**As risks go, having your car hacked ranks between falling off a hoverboard and losing cabin pressure on a Virgin Galactic flight. But last summer security researchers Charlie Miller and Chris Valasek used a vulnerability in a Jeep's Internet-enabled infotainment system to kill the transmission, proving that digital carjacking is at least technically possible. They have a few tips on how to make it out of (unlikely, but not inconceivable) vehicular cybersabotage alive. —ANDY GREENBERG**

**1.** Known attacks exploit features like parking assist to pull on the steering wheel. So keep hold—they likely can't overpower your grip.

**2.** Yank out anything plugged into the OBD2 port—an outlet under the dash that connects to the car's network. Internet-connected OBD gadgets can let hackers in.

**3.** If the brakes go out, pull the parking brake. If that's out, put the transmission in Park. "You may drop your transmission on the side of the road, but you'll stop," Valasek says.

**4.** If the car accelerates wildly, try to put it in neutral and guide it off the road (Fig. B).

**5.** Turn the car off, if possible, and wait a minute before you turn it on again. Malware may not have what hackers call "persistence," meaning that a restart could put control of the car back in your hands.

FIG. A

FIG. B

5 MINUTES CAN SAVE YOUR LIFE

# WALK AWAY FROM A PLANE CRASH

## SAFETY TIPS THE FLIGHT ATTENDANTS WON'T TELL YOU

**HERE'S A SURPRISING FACT:** The survival rate for accidents on US carrier flights is 95 percent. Another surprising fact: In accidents, airline passengers frequently get injured *after* the plane has come to a halt. If flight attendants (Fig. A) were allowed more latitude, they'd add these essential tips to their spiels about seat belts, motion discomfort bags, and tray tables. (If you're on your buddy's puddle jumper, ignore the one about the slides.) —BRENDAN I. KOERNER

### Dress for egress

Flips-flops make it easier to get through security, but they can get your feet crushed in a postcrash scramble for the exit. Wear long sleeves and long pants to avoid burns from any fires and scrapes from the safety slide.

### Count the rows

Make sure you know precisely how many rows separate your seat from the closest portal to freedom. If it's dark or smoky, you'll have to grope for an exit.

### Slide safely

Those inflatable yellow slides are more hazardous than they appear on the laminated safety cards—you can rocket off the side or snap a bone at the bottom. Cross your arms and your ankles, press your elbows to your sides, and point your toes to help you land properly.

### Stave off the smoke

The acrid smoke that often fills a battered fuselage can cause you to lose consciousness before you escape. Prepare to protect your lungs by traveling with a pocketable foldup respirator (Google "emergency escape mask").

### Stay visible

Don't pause to celebrate after you exit. Emergency vehicles have been known to hit people who linger near crashed planes. Turn on your phone's flashlight, then run from the wreck—preferably in a pack with other passengers.

MAKE THE TIME FLY BY

# GET THROUGH A BORING MEETING

### FIRST, CHOOSE YOUR TARGET

Look at the person across from you. Perhaps they are sitting with their left elbow on the table, chin on their hand. Cautiously mirror them, leaning forward to catch their eye. Be subtle. When you make eye contact, do a little nod. You're both bored, and now you've acknowledged it. You're united.

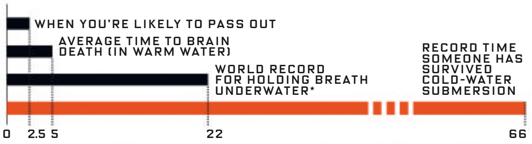
### THEN TEST YOUR BOND

Now cross your arms; see if they mirror you. A few minutes later, sit back and puff your chest out. Play around, but don't mirror them again until they start to follow you. If they do, you just made yourself a meeting friend. And you're probably still awake. —SHARA TONN

# YOU'LL LAST LONGER IN COLD WATER

Trapped underwater? Here are some fun facts to reflect on before your oxygen-deprived brain shuts down.

SUBMERSION SURVIVAL TIMES (MINUTES)



*HYPERVENTILATED WITH OXYGEN BEFORE ATTEMPT

88053
NO STEP
NO STEP

DAYS OF WOE

# GET FIRED RIGHT

### FIRST WALLOW, THEN REFLECT

I HAVE BEEN A MAGAZINE journalist in print and online for more than 20 years. In all that time, I'd never been fired (Fig. D)—until recently. I had a job, and then I didn't. Suddenly. ¶ Getting fired sucks. Unless you were playing an elaborate long con—in which case, well done, Mr. Ocean—the first thing that'll happen is a Bout of Crippling Self-Doubt. Maybe you'll watch *The NeverEnding Story* 18 times in a row, crying while eating cheeseburgers with whoopie-pie buns. Maybe you'll play *Destiny* tip to tail. Really marinate in it. I did. ¶ You're not going to want to take a hard look at yourself—especially after the whoopieburgers—but you need to. What really happened? Maybe you stopped caring about the job. Or started mentally chasing the next one. (Me.) Or the boss's spouse got slept with. (Not me.) Own it. But don't lie to yourself. ¶ Because you have to figure out how you're going to lie to other people. OK, maybe "lie" is a strong word, but you have to control your story. "The position evolved into something beyond what I was hired for" is not lying, exactly—it's James T. Kirk-ing. It's changing the conditions of the test. It's how to get back in the game. —MARC BERNARDIN

FIG. D

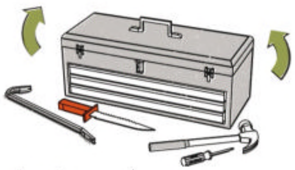


FIG. C

DAILY ESSENTIALS

# CARRY THIS STUFF AT ALL TIMES

### LIGHTWEIGHT GEAR FOR HANDLING UNEXPECTED SITUATIONS

Keeping emergency go-bags in your house and car is obligatory, but what if disaster strikes while you're at Baskin-Robbins? That's where a philosophy called Everyday Carry comes in. You should keep basic tools (Fig. C) on hand at all times. This gear can help you deal with disasters or just the little twists and turns of normal life. The best part: It all fits seamlessly into whatever clothing you typically wear. —WES SILER

**IN YOUR POCKETS**

**1. DPx Gear HEST/F Pocket Knife**
Designed for urban spaces, where the ability to smash a window or strip a wire is as important as self-defense. (There's a carbide glass-breaker on the pommel.)

**2. Naked Filter**
A micro-filament filter that screws onto most bottles, it removes 99.9999 percent of micro-organic contaminants from water.

**3. Goal Zero Flip 10 Recharger**
This minuscule USB charger is roughly the size of a ChapStick, but it can top up your phone.

**4. Pelican 1030 Micro Case**
The watertight, crush-proof polycarbonate housing is sized just right for a pair of glasses.

**5. Cash**
Don't count on ATMs. Carry the total amount you use in a typical day at all times (in small bills).

**6. Smartphone**
GPS still works when the grid is down. Install BackCountry Navigator TOPO GPS (Android) or Gaia GPS (iOS), and download topographic or street maps for your area.

**ON YOUR KEY CHAIN**

**7. Leatherman Style PS Multitool**
Pliers. File. Scissors. Tweezers. Screwdriver. Bottle opener.

**8. Foursevens Atom ALR2 Flashlight**
An integrated magnet on this tiny torch allows you to position the light while you work.

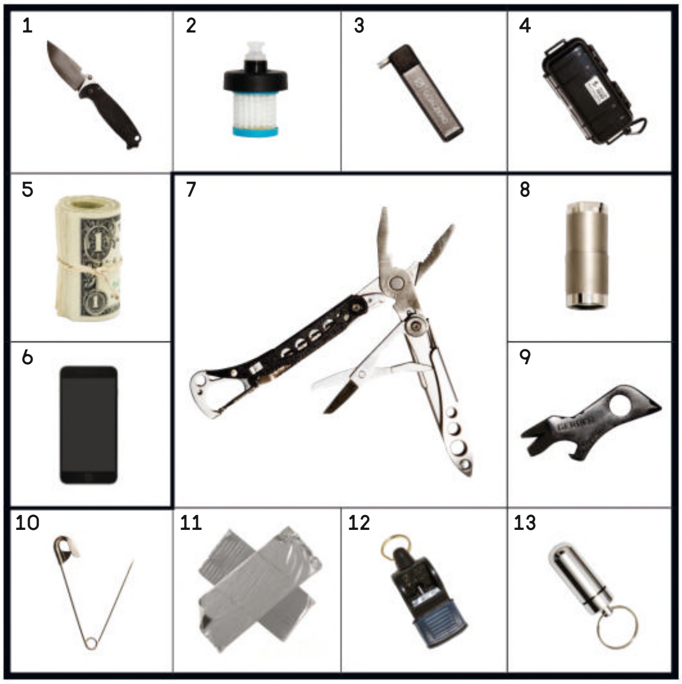
**9. Gerber Shard**
This pocketable pry bar can jimmy locks and open containers, tasks that might damage a knife blade.

**10. Safety Pin**
Clothing malfunction? Look no further. Loop the coil around your key chain for easy carry.

**11. Duct Tape**
You can tightly wrap 8 feet around a piece of paracord and it'll be no bigger than your pinkie.

**12. Fox 40 Classic CMG Whistle**
Three short blasts in quick succession is the international call for help. This model has a mouth guard and no moving parts.

**13. Outop Waterproof Aluminum Pillbox Case**
Secures essential prescription meds (or just emergency supplies of Imodium and Tylenol).



EVERYDAY CARRY PHOTOS: CHRISTIE HEMM KLOK, GETTY IMAGES (SAFETY PIN, DOLLARS)

**TECHNIQUE** from *100 Deadly Skills*, by former Navy SEAL **Clint Emerson**

# IN CASE OF ZOMBIES, MAKE THIS HOOLIGAN'S WEAPON

**Cities flood. Earthquakes strike. Terrorists foment chaos. If you need to keep it together in a tense environment for a few days, try these tips:**

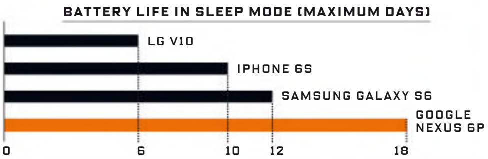
**1.**
For a makeshift club, stack 10 sheets of newspaper. Roll tight, fold in half, reinforce the ends with duct tape. Wet the paper to make it heavier, or add a nail for bonus brutality.

**2.**
Make a gas mask fast: Cut the bottom off an empty plastic jug so it fits over your face. Stick a wet sponge into the hole as a filter, and then seal it up with some tape.

**3.**
Rig up DIY body armor by taping books together with a layer of ceramic tiles on top. Use duct tape to create shoulder straps, and secure it to yourself by wrapping the adhesive horizontally around your torso.

## KNOW YOUR STANDBY TIME

If you're lost in the wilderness and holding out for a call or text from rescuers, put your phone in sleep mode so it'll last for days and days.



CHAPTER 3

# M

MONTHS

**A LENGTHY RUN-UP**

## PRACTICE, PRACTICE, PRACTICE

If you want to try something dangerous, like visiting the South Pole, traveling to Mars, or putting on a fourth-grade play, do a dry run first. Roald Amundsen, for example, spent years in the Arctic learning to survive before his push to the South Pole. We need to do the same if we want to go to Mars—this will give us key insights into the effects of long-duration spaceflight. I suggest we start with seven months orbiting the moon. Then a surface stay of 16 months, followed by more time in orbit. “Adventure,” as Amundsen said, “is just bad planning.” Smart rehearsal will keep those adventures to a minimum. —**ERIK SEEDHOUSE** is an expert in space medicine

**TECHNIQUE**

# IF YOU’RE FORAGING FOR FOOD, YOU WANT TO LOOK FOR THE EASIEST CREATURES TO KILL AND PREPARE

BUGS, PORCUPINES, FISH, SNAKES, SHELLFISH, AND GROUND-NESTING BIRDS LIKE QUAIL FIT THE BILL AND ARE THUS SOME OF THE MOST EFFICIENT SOURCES OF PROTEIN AND CALORIES IN THE WILDERNESS

FIG. E

MONTHS AND MONTHS ON THE MOVE

# WHEN IT'S TIME TO RUN, RUN

## REFUGEES FROM WAR CAN'T SURVIVE ON HOPE ALONE, BUT HOPE DOES HELP KEEP THEM ALIVE

**WHEN ARMED** rebels advanced across the Sierra Leone border, I ran for seven hours to my mother's village because she was alone with my grandmother. I was only 17, but I wanted to protect them. Eventually, the rebels overwhelmed the region and took our village as a base. My mother, sister, and I decided to escape. My grandmother could not walk, so before we left I brought her food, water, and firewood and said I'd return tomorrow. I never saw her again.

We ran toward a river. On the way, we agreed on a route of villages we'd flee to in case we had to separate. Sure enough, rebels stopped us at the river's bank. I acted aggressive so that the rebels would think I was with them, then jumped into the water, grabbed a canoe for my mother and sister, and pushed it into the current. To survive, you need to read situations quickly and respond confidently. Battle broke out the following day. I hid in the bushes, then walked upstream for weeks. When I came across abandoned settlements, I searched houses for commodities. Salt was gold. You need seasoning when you're eating what you find in the bush: leaves, roots, fish, opossums (Fig. E). I took matches to cook with and tobacco to trade. Money was worthless.

When I found my mother and sister, we fled to Liberian border towns where the fighting had paused and thousands of Sierra Leoneans had set up tents. We stayed for 10 months, but we'd flee into the jungle when fighting flared. We'd farm small plots of land we'd cleared, make traps to catch bushmeat, and teach one another which roots and fruit to eat.

We got rashes, and flies landed on the bushmeat we set out to dry, so we got worms. We learned which types of bark could be ground up to soothe wounds, and we'd collect bitter roots to treat the worms. Certain birds made a particular kind of call when humans approached, and we'd listen for that so we could tell one another when we heard those sounds. Eventually we ran more than 70 miles in 24 hours, wearing flip-flops, to a United Nations refugee camp in Monrovia. I lived in tents at that camp for nearly four years until I finally got a visa to the United States.

You just want to live, so if you need to run, you run. You have bad dreams. You could be dead the next day. I don't know how I made it, but I think it's because I saw hope. I told myself, this will be over and I will have a good life. —MUSTAPHA WAI, AS TOLD TO AMY MAXMEN

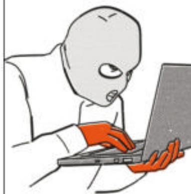


FIG. F

LONG-TERM FALLOUT

# DEFLECT DOXERS

## 5 DEFENSES AGAINST ONLINE HARASSERS

**Of all the forms of online harassment, doxing is perhaps the most pernicious. Perpetrators (Fig. F) publish your address or other info online, exposing you to escalating abuse, even physical violence. It can be terrifying, and the repercussions can be lasting. Don't blame yourself, though, and don't let anyone tell you the harassment isn't real. Surround yourself with people who support you, take the situation seriously, and take action. —LAURA HUDSON AND ANITA SARKEESIAN**

**Stay secure**
Don't send sensitive details via insecure email or text messages, and set up two-step verification and complex passwords to help prevent the hacking or hijacking of your accounts.

**Scrub the net**
Search for your name, address, and phone number at people-finder websites like Spokeo and Whitepages and ask to be removed. Encourage your loved ones to take similar steps, as harassers may dox the family and friends of their target.

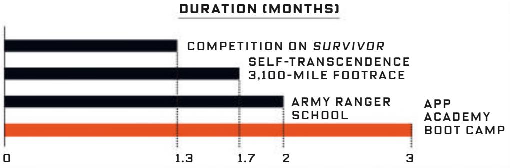
**Act fast**
If doxers publish your information on social media, report it immediately and ask that it be taken down.

**Tell the cops**
Document threats you receive, and if you think you're in danger, call the police. Even if they do nothing, it's good to get a report on file. Ask to speak with an officer who specializes in online crimes. (If your local department doesn't have one, avoid Internet jargon like, well, doxing.)

**Enlist support**
Ask trusted friends to monitor, document, and report abusive messages on your social media accounts or in your inbox, so you can take a step away mentally but still know the situation is being handled.

## AMAZING ENDURANCE TESTS

People intentionally push their minds and bodies to the limit to complete punishing challenges like these.



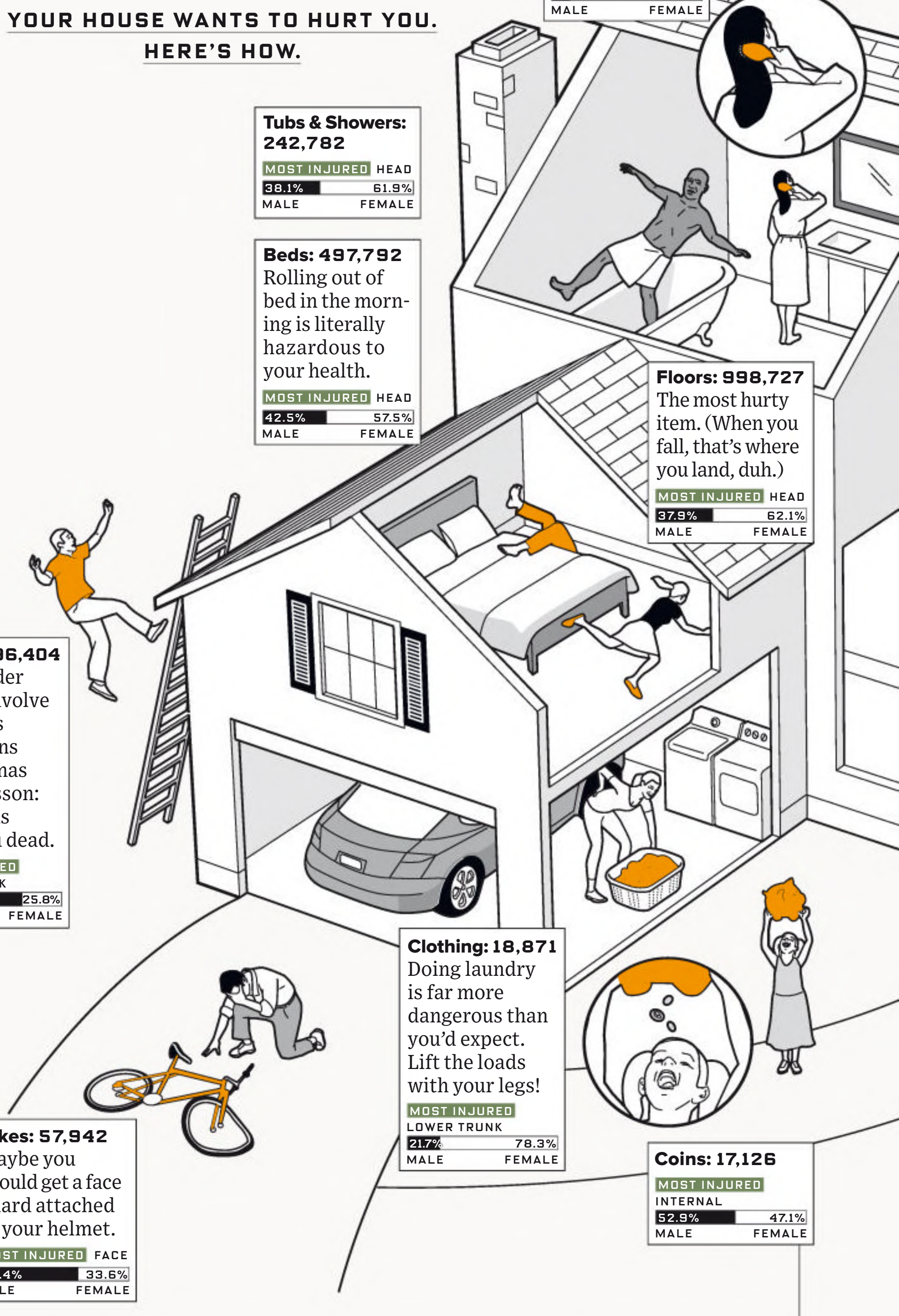
CHAPTER 4

YEARS

ANNUAL INJURY RATES

# DOMESTIC TERRORISM

YOUR HOUSE WANTS TO HURT YOU. HERE'S HOW.



**Combs or Hairbrushes: 1,857***

MOST INJURED NECK

| MALE | FEMALE |
|---|---|
| 12.2% | 87.8% |

**Tubs & Showers: 242,782**

MOST INJURED HEAD

| MALE | FEMALE |
|---|---|
| 38.1% | 61.9% |

**Beds: 497,792**
Rolling out of bed in the morning is literally hazardous to your health.

MOST INJURED HEAD

| MALE | FEMALE |
|---|---|
| 42.5% | 57.5% |

**Floors: 998,727**
The most hurty item. (When you fall, that's where you land, duh.)

MOST INJURED HEAD

| MALE | FEMALE |
|---|---|
| 37.9% | 62.1% |

**Ladders: 96,404**
Many ladder injuries involve Christmas decorations or Christmas lights. Lesson: Baby Jesus wants you dead.

MOST INJURED LOWER TRUNK

| MALE | FEMALE |
|---|---|
| 74.2% | 25.8% |

**Clothing: 18,871**
Doing laundry is far more dangerous than you'd expect. Lift the loads with your legs!

MOST INJURED LOWER TRUNK

| MALE | FEMALE |
|---|---|
| 21.7% | 78.3% |

**Bikes: 57,942**
Maybe you should get a face guard attached to your helmet.

MOST INJURED FACE

| MALE | FEMALE |
|---|---|
| 66.4% | 33.6% |

**Coins: 17,126**

MOST INJURED INTERNAL

| MALE | FEMALE |
|---|---|
| 52.9% | 47.1% |

*ESTIMATED INCIDENTS PER YEAR

YEARS ON THE ROAD

# SURVIVE A PRESIDENTIAL CAMPAIGN

FIG. G

Presidential campaign coverage is a grueling ordeal, an unforgiving assignment—and an amazing journey. Here are a few road-tested survival tips.

Expect to make enemies. If you get to South Carolina and you haven't been yelled at by campaign staffers, you're not doing your job. Please note: Even the pols you like and trust may lie to you. It's not their responsibility to tell the unvarnished truth. It's yours.

What may prove to be the toughest part of a difficult logistical situation is sleep—it will be rare. So buy a neck pillow, sunglasses, and earbuds, and grab z's every chance you get, even on that 45-minute flight from Midwest city 1 to Midwest city 2 (Fig. G). Your nerves will be frayed, so do your future self a favor and don't send that angry email. Reconsider in the morning; phone calls may be preferable. What's true for your body is true for your smartphone. Eat when you can, and charge your devices any time you're near an outlet.

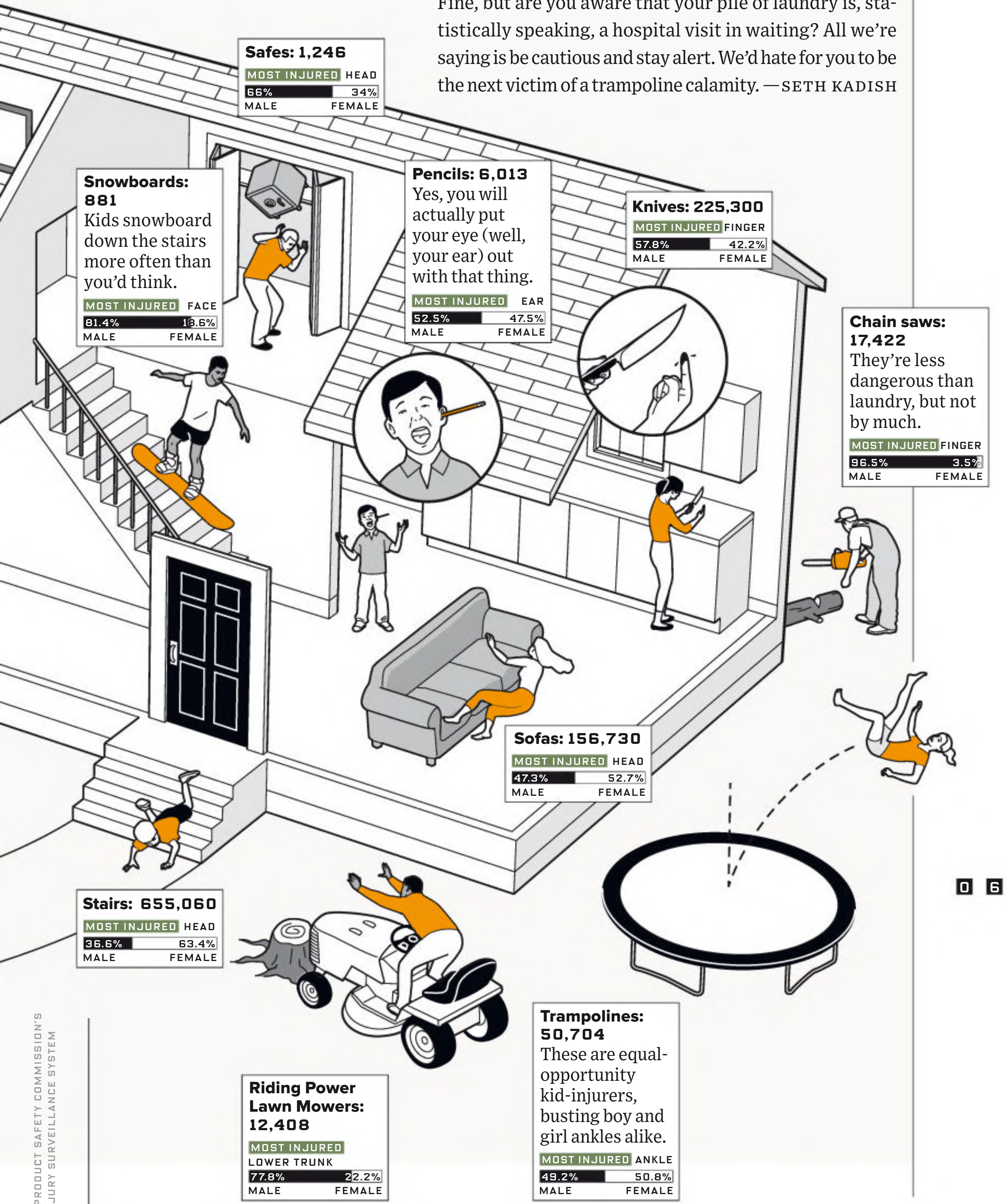
Other notes: Free food and drink are not without calories or repercussions. When it comes to getting up in the morning, do not rely on the hotel's wake-up call, and triple-check your time zone before setting your alarm. Save your receipts and do your expenses every couple days. I know, I know. But still.

You should also expect to make friends that you keep for a lifetime—probably your fellow journalists. But be nice to everyone. Campaign herders and luggage handlers are there for idealistic reasons. Befriend the cameramen and -women; photojournalists have wisdom. And in some cases, wizardry.

Oh, and for the unattached among you, keep your eyes peeled. I met my future wife in the Chequers bar at the Hotel Fort Des Moines.

—JAKE TAPPER
Anchor, *The Lead* and *State of the Union*, CNN

**A HOUSE ISN'T JUST A HOME.** It's a collection of sharp objects, unstable ladders, and slippery floors. So we've compiled a guide to some of the most common pitfalls (and we do mean *falls*) that await you. You may mutter, "Thanks, but I already know not to dive down the stairs." Fine, but are you aware that your pile of laundry is, statistically speaking, a hospital visit in waiting? All we're saying is be cautious and stay alert. We'd hate for you to be the next victim of a trampoline calamity. —SETH KADISH



**Safes: 1,246**
MOST INJURED HEAD
66% MALE | 34% FEMALE

**Snowboards: 881**
Kids snowboard down the stairs more often than you'd think.
MOST INJURED FACE
81.4% MALE | 18.6% FEMALE

**Pencils: 6,013**
Yes, you will actually put your eye (well, your ear) out with that thing.
MOST INJURED EAR
52.5% MALE | 47.5% FEMALE

**Knives: 225,300**
MOST INJURED FINGER
57.8% MALE | 42.2% FEMALE

**Chain saws: 17,422**
They're less dangerous than laundry, but not by much.
MOST INJURED FINGER
96.5% MALE | 3.5% FEMALE

**Sofas: 156,730**
MOST INJURED HEAD
47.3% MALE | 52.7% FEMALE

**Stairs: 655,060**
MOST INJURED HEAD
36.6% MALE | 63.4% FEMALE

**Riding Power Lawn Mowers: 12,408**
MOST INJURED LOWER TRUNK
77.8% MALE | 22.2% FEMALE

**Trampolines: 50,704**
These are equal-opportunity kid-injurers, busting boy and girl ankles alike.
MOST INJURED ANKLE
49.2% MALE | 50.8% FEMALE

SOURCE: U.S. CONSUMER PRODUCT SAFETY COMMISSION'S NATIONAL ELECTRONIC INJURY SURVEILLANCE SYSTEM

THE GOLDEN AGE

## TRICK END-TIMES METAL TRADERS

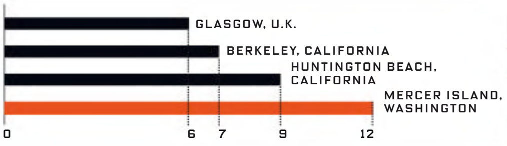
**If you want to sock away gold for TEOTWAWKI* but lack the funds to buy it at $1,135 an ounce, get some gold-plated tungsten coins. Tungsten and 24K gold have almost the same density, so fakes mimic the real deal in a water displacement test. (The Archimedes-in-the-bath thing.) But don't try this trick with more sophisticated traders: Sound travels faster through tungsten, and end-times precious-metal barons might carry ultrasonic detectors to spot fakes. If you suspect you're the one getting chumped, get the propane torch from your go-bag. (You do have a propane torch in your go-bag, right?) It burns at 3,600 degrees Fahrenheit, hot enough to melt the gold layer and reveal the tungsten core. —KEITH VERONESE**

*PREPPER-SPEAK FOR "THE END OF THE WORLD AS WE KNOW IT"

## RULE-FREE PLAY WITHOUT PARENTS

Forget slides and sandboxes. Adventure playgrounds in a number of cities offer kids unstructured fun with scrap wood, old tires, and mud.

AGE KIDS CAN GO SOLO AT THE LOCAL ADVENTURE PLAYGROUND



YOU MUST BE THIS TALL

CHAPTER 5

DECADES

LAST FOR EONS

# LEARN FROM ANCIENT CIVILIZATIONS

### THE MAYANS KNEW HOW TO KEEP SOCIETY GOING

**TO ARTHUR DEMAREST,** a real-life Indiana Jones who has spent decades sifting through the rubble of lost cultures, the West today looks a lot like the Mayan world of AD 750: a golden age that presaged the fall. "Civilizations don't fade away," the Vanderbilt archaeologist says. "They peak and then rapidly disintegrate"—growing too fast, consuming too much, drunk on their own grandeur. And in our hyperconnected world the end could come fast, as a collapse in one country or industry cascades into global disaster. To avoid that fate, Demarest says, we need to slow down, put survival above progress. It's like the process of belaying in rock climbing: "You can skip it and climb faster, but at some point you'll die." The Mayans themselves stepped back from the brink around AD 300, he says, trading slash-and-burn agriculture for smaller, diversified farms. It meant lower yields and less wealth to support armies or build temples—but hey, they lasted another 600 years. —SARAH ZHANG

ETERNAL LOVE

# STAY MARRIED

### HOW TO FULFILL THOSE PROMISES

The secret is in working the brain chemistry behind love, says the Kinsey Institute's Helen Fisher. —LEE SIMMONS

**Go slow, Romeo**
Romance triggers the same mind-deranging dopamine circuitry as cocaine. No Vegas weddings.

**Be surprising**
That love high thrives on novelty: Bring flowers *not* on Valentine's Day (Fig. I).

**No dalliance**
Sex sparks a chain reaction in your brain that leads to attachment. That's nature's recipe for families. Be strong. Semper fi.

**Hold hands**
A simple touch showers your partner's brain with oxytocin, letting them know all is right in your (shared) world.

FIG. H

FIG. I

A 100-YEAR PLAN

# MAKE FEWER BABIES

### LET'S SURVIVE BEYOND THE NEXT CENTURY

Alan Weisman thinks about the end of the world. A lot. His book *The World Without Us* describes what would happen if humans suddenly vanished. In *Countdown*, his follow-up, he examines what it will take to keep us going on a planet that is staggering under the weight of too many people (7.4 billion and counting) and too much carbon dioxide. We asked him how we can ensure a human-habitable planet decades from now. —SARAH FALLON

**If you could magically make a law that would help humanity survive, what would it be?**
There is no zero-emission energy yet. Just to mine the metals to make the solar collectors or the wind turbines incurs a big carbon debt. We need to reverse the demands on energy. That means we have to have fewer people (Fig. H).

**So how long would it take for this population freight train to stop?**
If we were all willing to embrace a one-child policy, the population would continue to increase for the next couple of generations, but then it would peak and drop off dramatically. By the end of the century, we would be down to a little over 1.5 billion people.

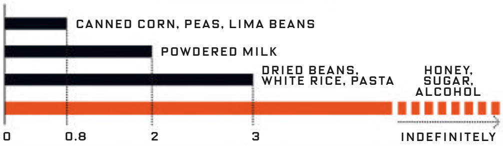
**And that's a sort of "correct" number?**
Well, the problem is that everybody hates the one-child policy. When you tell people it's OK to have two children, though, suddenly everybody relaxes, because that just sort of feels acceptable. If female education were universal right now, that would—without any laws—guarantee that families would have fewer children. By the end of the next century, we could be closer to 6 billion people. And after that we'd still be descending toward a much more sustainable population.

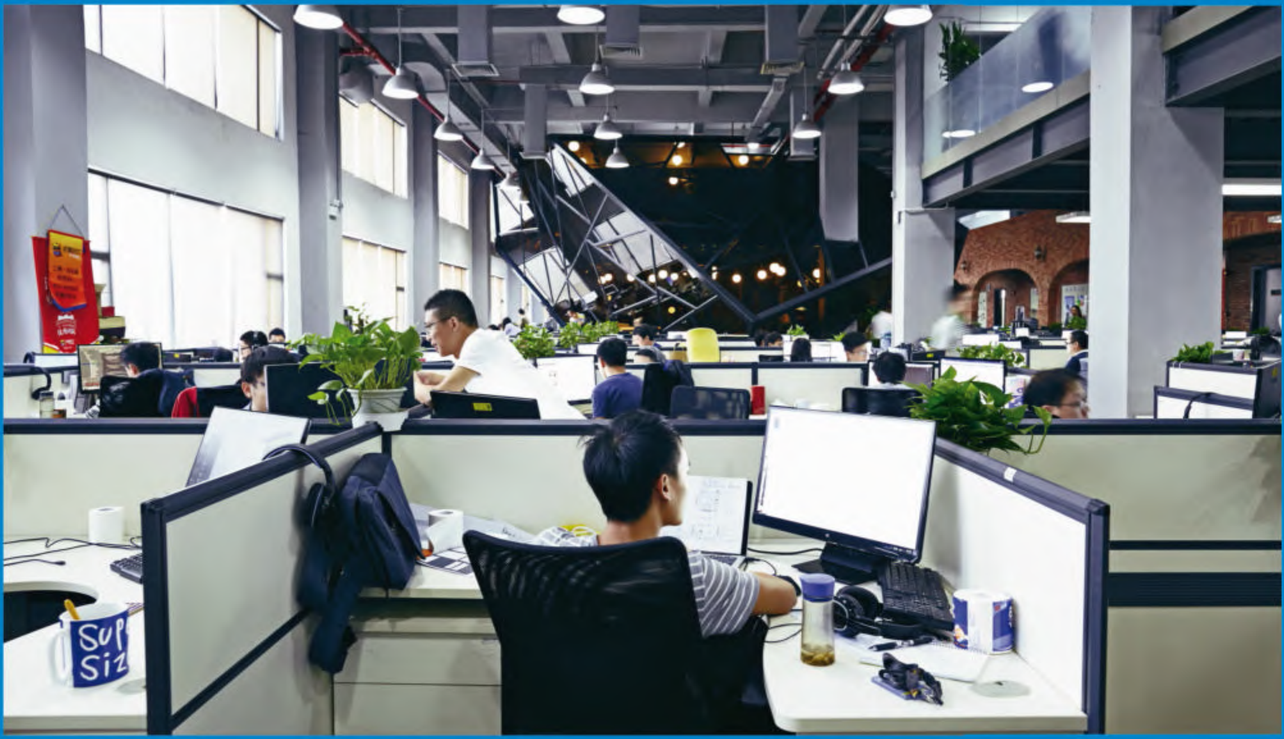
**So the technology we need has already been invented.**
Yes, and it's extremely cheap. I guess the only law I would make is that every country has to contribute money so there is contraception available to everyone who wants to use it. And they have to get rid of laws saying you can't use it.

# PREPARE FOR HUNGRY TIMES

Fridges will be useless once the grid gives out. Keep the right victuals in a cool, dry spot and you're good until 2036.

SHELF LIFE (DECADES)

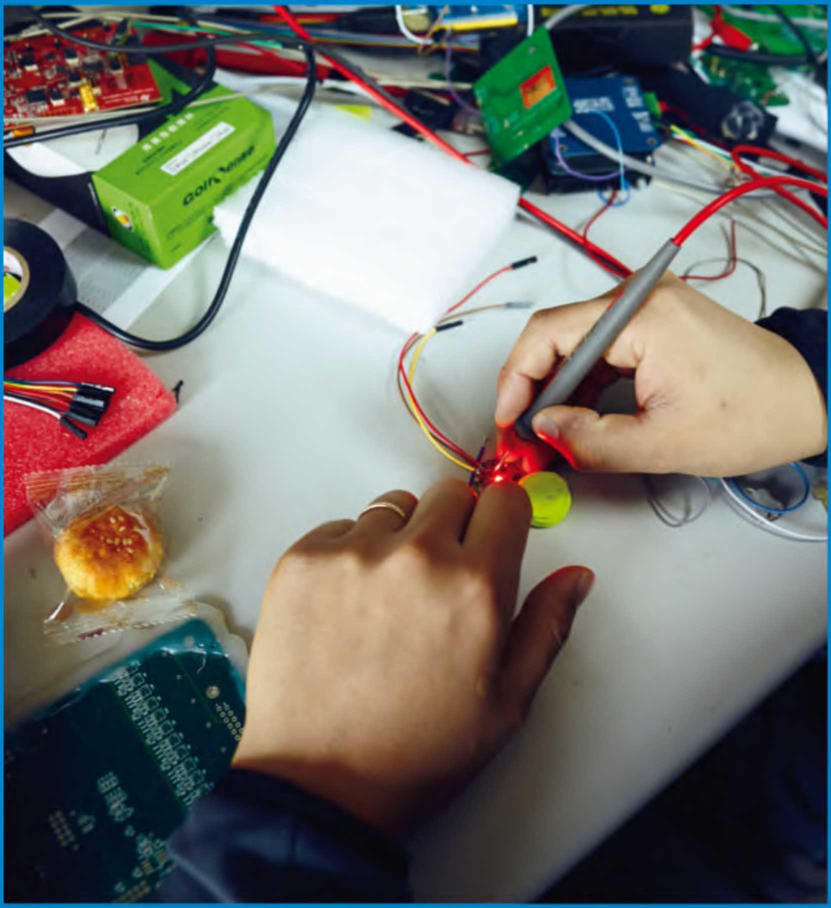




Livestreaming enterprise YY

XinCheJian hackerspace

Meituan worker



Sensor startup Zepp Labs

Ecommerce giant Meituan

Rising mobile star Xiaomi

# HOW A NATION OF TECH COPYCATS

# 创

# TRANSFORMED ITSELF

# 业

# INTO THE NEW HUB FOR INNOVATION.

# 中国

BY CLIVE THOMPSON
PHOTOGRAPHS BY ZACHARY BAKO

新

THE YOUNG PROGRAMMER HAD AN IDEA, and everyone thought it was nuts. Just out of college, he'd gotten a job writing software for YY, a livestreaming company based in the massive city of Guangzhou, in China's Pearl River Delta. More than 100 million users every month stream themselves, or tune in to broadcasts of others, singing, playing videogames, or hosting talk shows from their Beijing apartments. The audience chats back, prolifically, via voice or text.

The programmer thought YY should try something new: use its proven streaming technology to run a dating service, which would operate kind of like a TV dating show. A host would set up an online lounge, then invite in some lonely singles and coax them to ask each other questions and maybe find a partner.

Company executives were dubious. "The CEO almost killed it," says Eric Ho, chief financial officer, sitting in YY's headquarters, atop three floors of furiously coding engineers and designers. Are you sure you want to do this? the CEO asked the kid. This is very stupid. I don't think people will like it! But the programmer was hungry and persistent, so they waved him on: Give it a try.

In China, this type of employee didn't used to exist. Ten years ago, high tech observers complained that the nation didn't have enough bold innovators. There were, of course, wildly profitable high tech firms, but they rarely took creative risks and mostly just mimicked Silicon Valley: Baidu was a replica of Google, Tencent a copy of Yahoo, JD a version of Amazon. Young Chinese coders had programming chops that were second to none, but they lacked the drive of a Mark Zuckerberg or Steve Jobs. The West Coast mantra—fail fast, fail often, the better to find a hit product—seemed alien, even dangerous, to youths schooled in an educational system that focused on rote memorization and punished mistakes. Graduates craved jobs at big, solid firms. The goal was stability: Urban China had only recently emerged from decades of poverty, and much of the countryside was still waiting its turn to do so. Better to keep your head down and stay safe.

That attitude is vanishing now. It's been swept aside by a surge in prosperity, bringing with it a new level of confidence and boldness in the country's young urban techies. In 2000, barely 4 percent of China was middle-class—meaning with an income ranging from $9,000 to $34,000—but by 2012 fully two-thirds had climbed into that bracket. In the same time frame, higher education soared sevenfold: 7 million graduated college this year. The result is a generation both creative and comfortable with risk-taking. "We're seeing people in their early twenties starting companies—people just out of school, and there are even some dropouts," says Kai-Fu Lee, a Chinese venture capitalist and veteran of Apple, Microsoft, and Google, who has spent the past decade crisscrossing the nation, helping youths start firms. Now major cities are crowded with ambitious inventors and entrepreneurs, flocking into software accelerators and hackerspaces. They no longer want jobs at Google or Apple; like their counterparts in San Francisco, they want to *build* the next Google or Apple.

Anyone with a promising idea and some experience can find money. Venture capitalists pumped a record $15.5 billion into Chinese startups last year, so entrepreneurs are being showered in funding, as well as crucial advice and mentoring from millionaire angels. (It's still a fraction of the US venture capital pool from 2014, $48 billion.) Even the Chinese government—which has a wary attitude toward online expression and runs a vast digital censorship apparatus—has launched a $6.5 billion fund for startups. With the economy's growth slowing after two decades of breakneck expansion, the party is worriedly seeking new sources of good jobs. Tech fits the bill.

The new boom encompasses both online services and the hardware arena. Recent local-kid-makes-good models like Xiaomi, the fast-rising Beijing mobile phone firm, or WeChat, Tencent's globe-conquering social networking app, are leading the way forward. Homegrown firms have distinct advantages, namely familiarity with local tastes, the ability to plug into a first-class manufacturing system built for Western companies, and proximity to the world's fastest-growing markets in India and Southeast Asia. The combination of factors is putting them in a position to beat the West at its own game. Xiaomi, for example, was the fourth-highest seller of mobile phones worldwide last year, behind Samsung, Apple, and Huawei.

CHINA'S TECHIES DON'T WANT JOBS AT APPLE OR GOOGLE—THEY WANT TO BUILD THE NEXT APPLE OR GOOGLE.

As for YY, it turns out it was good that the execu-

YY programmer Mo Wengang

YY hosts user performances, live gaming, and a dating show.

tives indulged their enterprising programmer. The dating show launched last year and became a hit. It also generated serious profits. YY has no advertising; it earns revenue when users fork over real Chinese currency to buy virtual items they give as gifts to each other or to the "broadcasters" streaming their own lives online. YY takes a 60 percent cut of each purchase, with the recipient getting the rest as actual cash. (Popular broadcasters make so much money that they live off their YY earnings.) At a laptop on Ho's table, I peer at the screen, where a dating event is livestreaming. Money is flying around as male and female guests give each other—and the host—virtual presents: rings (worth $1.55), kisses (16 cents), and love letters (5 cents). Some items are pricier yet; for about $1,000, you can buy someone a virtual Lamborghini. In its first nine months, YY's dating show brought in about $16 million, a sum growing rapidly every month. Last year YY itself brought in $580 million, and three years after going public on the Nasdaq, its market cap tops $3 billion, even after the market gyrations of 2015. The next Silicon Valley has emerged—and it's in the East.

* * *

**CHINA'S TECH BOOM** in the late '90s produced its own Web 1.0: search engines, email and blogging tools, news portals, and Alibaba's sprawling online sales market. Back then, China very much needed local copies of US companies, because US firms often couldn't operate easily in China. The government blocked many foreign sites by using a complex system of filters known as the Great Firewall of China. Local firms had an edge anyway: They understood the particular demands of the Chinese digerati in the early '00s, when Internet access was still scanty. Ten years ago, for example, eBay tried to dominate in China but failed, partly because many small businesses—the places that might otherwise have used eBay to sell their products to the world—didn't yet have computers or a connection to the Internet. At Alibaba, however, founder Jack Ma understood this, so he assembled a huge sales force that fanned out across the country, teaching merchants how to get wired. (He also outcompeted eBay's PayPal with Alipay, which holds a buyer's payment in escrow until they receive their goods and pronounce themselves happy with the purchase; this helped build trust in online markets.) Riding that first crest, firms like Baidu and Alibaba became the "big dragons" of Chinese high tech, minting millionaires much as Microsoft had in the '90s.

The success of copycat firms paved the way for "little dragons"—creative, upstart Web 2.0 firms that emerged in the late '00s. The big dragons provided role models,

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Zepp Labs' Beijing office

Zepp cofounder Robin Han

but even more significantly, they built the infrastructure crucial for today's high tech boom, including the cloud services that allow any twentysomething to launch a business overnight and immediately start billing customers.

One of the most successful in this second wave is Meituan, a firm that has become an ecommerce giant by enabling small merchants across the country to broadcast deals to nearby shoppers who have opted in, on the web and within Meituan's mobile app. When I visit the Beijing headquarters, it looks like a tropical forest: There are leafy green plants plunked down between each workstation, while humidifiers puff clouds of moist air upward. It's nearly silent, but there's a lot of money flowing through the office. Suspended above dozens of coders is an LCD the size of a table for four that reads "8,309": the number of deals Meituan has broadcast so far today. The firm's revenue has skyrocketed in its five years of operation; in 2014 it processed more than $7 billion in deals for its 900,000 partners. It's aiming to reach $18.5 billion by the end of this year.

Meituan's CEO, the slender and soft-spoken Wang Xing, is a serial entrepreneur who tracks the emerging creative shift in Chinese startups. He had already made Chinese clones of Facebook and Twitter when, in 2008, he noticed the rise of Groupon. "There's no doubt that we got influenced by Groupon," he admits. But by then he was seasoned enough to spot the flaws in the discounter's business model. Groupon took a big cut—up to 50 percent—of the revenue from each deal, which left participating merchants bitter. They'd routinely lose money by issuing Groupon deals, so they'd grit their teeth and hope it would attract new permanent customers; usually it didn't. Wang, in contrast, wanted to make Meituan the easiest way for small merchants to charge their customers and stay in contact with them. Setting Meituan's cut at only 5 percent ensured that merchants nearly always made money.

He also began developing proprietary ecommerce tech. Wang whips out his phone to show me a recent example. His programmers fanned out to movie theater chains across the country, laboriously connecting Meituan's app to their booking systems. It was a hassle, but now moviegoers can not only buy a ticket from the Meituan app, they can pick their seats. Wang clicks on *The Hobbit* to show me. "When you go to the theater you don't have to wait in line and talk to any people—you can just go to a vending machine and scan your passcode" to get in, he says. It's slick and simple, and now one-third of all movie tickets in China are bought via Meituan. Last year it was 10 percent of the firm's annual income.

It's an adroit move, because service—and convenience—is what China's urban middle class increasingly craves. Sporting high-end mobiles and elite fashion from Europe, they pull out their phones for nearly every purpose: using Alipay to cover a cab ride to a DJ'd party in the artistic outskirts of Beijing; opening WeChat and using its location-sharing function so their friends can find them; posting selfies on Meitu, a picture-sharing service with built-in beautifying filters. The service economy commanded 44 percent of

all money spent by the Chinese middle class in 2013, a figure that consulting firm McKinsey expects will grow to 50 percent by 2022, as young urbanites splurge via their phones on everything from massages to takeout food, hairstyling, and nail salons. Even the market meltdown of this year doesn't seem to have dented middle-class consumption: During China's travel-focused Golden Week national holiday in October, box office sales were up 70 percent over the previous year, and overseas trips were up 36.6 percent, according to Bank of America–Merrill Lynch analysts.

Ecommerce, already big in China, has an astonishing amount yet to grow—a tremendous number of everyday services are not yet online. For example, 80 percent of China's hotel rooms are still booked offline. And people are eager for ecommerce not just because it's convenient, but because it's much less corrupt and opaque than brick-and-mortar businesses. As Kai-Fu Lee points out, the latter are, by American standards, riddled with inefficiencies and hucksterism. "In the US, hundreds of years of fair competition made commerce relatively fair and transparent," he says. Not so in China. "If you were to sell real estate, there is no transparency. If you buy a used car, there is no *Consumer Reports* or Ralph Nader." By removing middlemen and creating reputation systems, ecommerce firms are making transactions more transparent and trustworthy, he argues. "So a mobile social-based solution will be dramatically better," Lee says.

Corruption is just one of the many challenges China faces. The country's leaders and investors also contend with nontransparent banks, government regulators on the take, rampant pollution, fierce crackdowns on political speech, and a rural population yearning for better jobs in the cities. It's not clear whether the party can solve all these messy problems.

In the short run, though, the high tech gold rush has produced manic and fierce competition. Whenever a new category opens up, it's immediately swarmed upon by dozens or even hundreds of entrepreneurs. By comparison, competition in the US is mild; for example, there are only two major firms—Uber and Lyft—duking it out for car bookings. But Lee estimates that in its early days, Meituan had to fight 3,000 competitors dotted across the country. Whoever is left standing is battle-hardened. That's Wang now. Halfway between the old guard and the new, he has become an angel investor himself, on the lookout for youngsters with daring ideas: the next little dragons. One company he's investing in is eDaijia, which, rather hilariously, lets car owners find someone to drive their vehicle home when they're drunk. "They are totally dominant in China, and last year they went to Seoul," he laughs, "because, they told me, that's the most drunk city in the world."

**CHINA'S CREATIVE** boom in web services is significant enough, but arguably it has an even bigger edge over the US in hardware. The country has spent 30 years becoming the manufacturing capital of the world, so coastal cities like Shenzhen and Guangzhou are now crammed with electronics facilities, from tiny three-person shops to Foxconn's 30,000-employee city-factory complexes cranking out iPhones. All have a deep knowledge of how to make things, so it was almost inevitable that homegrown entrepreneurs would get in on the act.

Living next to the factories or being able to stroll the electronics markets, they're the first to know when trends in hardware emerge: for example, when a cutting-edge sensor arrives that lets you collect new forms of data—or when the cost of an existing one suddenly drops to a penny, allowing it to be sprinkled anywhere, like dust.

"It's easier in China than in other places," Robin Han says, "because we have Shenzhen." Han is the 32-year-old cofounder of Zepp Labs, a Beijing-based hardware startup that is the darling of the sports world: It makes a square sensor that tracks your swing—of a golf club, a baseball bat, a tennis racket—then uses an iPhone app to help you improve. Han got the entrepreneurial itch five years ago as a PhD student working in Microsoft's Beijing research office. Big-company life might be stable, but you could toil for years on a project that might never become a real product. Success was out of your control, he tells me, sitting in the brightly lit Zepp office, where, behind him, two dozen coders and designers pilot keyboards. Han had noticed gyroscopes being used in HTC and HP phones as well as Nintendo Wii remotes and figured they would go down in price as big companies continued to include them in their products. That had potential. He and a friend, Peter Ye (now Zepp's head of R&D), loved sports and hit on the idea for a swing sensor. Players could analyze their motions or compare them to those of professionals; coaches could scrutinize an entire team's practice swings, even remotely. Han and Ye started with golf. They figured duffers would be willing to spend money on a sensor that promised to improve their game. They lead me to the basement, where they have constructed a huge batting-and-golfing cage. "We spent a lot of hours in here perfecting the sensors and working on our swings," Han says. The walls are studded with marks from errant balls. Their prototype worked so well it attracted the attention of an Apple rep who was touring China, looking for products for the Apple Store. Satisfying Apple's precise aesthetics required them to slowly refine the design through 14 prototypes, but it paid off: Since the Zepp sensor launched in Apple Stores worldwide in 2012, Zepp has activated more than

THE HIGH TECH GOLD RUSH HAS PRODUCED MANIC AND FIERCE COMPETITION AMONG THE SWARMS OF ENTREPRENEURS.

300,000 of them. Han and Ye got Zepp Labs off the ground with $1.5 million in seed money from angel investor Xiao Wang and worked their contacts to find a good factory to help prototype and mass-produce their device. That last step—finding a talented, Foxconn-class factory that has deep experience in elegantly solving design challenges—has traditionally been the hard part of getting things made in China. But in recent years, that's gotten easier too. A set of middlemen has emerged specifically to help bridge that gap, including Highway 1, a program by the manufacturing giant PCH: It picks gadget inventors from around the world and finds topflight factories willing to take a risk manufacturing a product by an unknown new talent.

There's also been a hackerspace movement in China. The first one—Shanghai's XinCheJian—was cofounded in 2010 by Chinese Internet entrepreneur David Li, when he noticed how cheap prototyping tools were allowing kitchen-table inventors to produce increasingly slick prototypes. Now local creators from across China mix with expatriates who flock to XinCheJian from around the world, brainstorming ideas with each other and going on tours of factories organized by Li to help them understand how China's hardware ecosystem works. Much like a gym, members pay monthly fees to XinCheJian, which gives them access to the hackerspace's tools and, just as important, advice and networking from fellow inventors. "I always encourage people: Get to your prototype fast, try to find manufacturing partners, and get your Kickstarter campaign finished," Li tells me, sitting at the hackerspace's main table, in front of a fridge emblazoned with a sticker that reads DO EPIC SHIT. The rooms behind him are filled with metal lathes, electric tools, and rows of 3-D printers. One successful product that recently emerged from XinCheJian is Wearhaus headphones, which enable one person to stream music from their phone while friends listen in, letting them privately enjoy the same music while, say, coworking or studying. The first run of 3,000 headphones sold out, and now a larger run is in the pipeline.

盛

**THE ACME OF** China's innovation boom can be found in four office towers that loom over a sprawl of condos in the suburbs of Beijing. These are the headquarters of Xiaomi. Founded in 2010, the company has become famous for making mobile phones comparable to the iPhone—fast processors, large screens, and a sleek operating system called MIUI—but at half the cost. It may be even more famous for its chiefly online sales model and explosive growth. Xiaomi sold 61 million phones last year, and for part of 2015 it was the top-selling mobile brand in China. Though it's still private, last year investors said it was worth $45 billion.

Xiaomi was founded by a serial entrepreneur who got a chance to make his early mistakes—and fortune—10 years ago: CEO Lei Jun founded the online bookseller Joyo, which he later sold to Amazon. He quickly became an angel investor, pouring money into the next generation of innovators, like YY, and making connections with the country's brightest young designers and engineers. By 2010, a new vision had taken hold: to build an operating system and a new business model for selling mobile phones. Lei formed Xiaomi and hired a team of crack talent to quickly produce a gorgeous mobile phone OS and put it online in August of that year. China's techies loved it. But only the most nerdy were willing to endure the hassle of downloading an OS to their existing phones. If Xiaomi wanted to get the system into the hands of millions, it would need to make—and sell—handsets. Foxconn became one of Xiaomi's primary manufacturers. Meanwhile, the startup hit upon a hugely effective sales system. Each new model would initially be sold in a limited quantity—perhaps 50,000—via a weekly flash sale on its website. The exclusivity drove fans wild. The lucky few who scored phones would flaunt them to their envious hipster friends—and later, Xiaomi would open up a larger run to satisfy pent-up demand.

Xiaomi's office is brightly lit and decorated with huge paintings. A mutt that workers adopted off the street sleeps in his doghouse on the first floor. One flight up, a sprawling room is filled with customer-service reps chattering into phones, attempting to solve users' issues around the world. Though China is Xiaomi's largest market, in 2013 the firm hired Hugo Barra, previously Google's product manager for Android, to oversee global expansion. "These are phones for the generation that will never have access to a computer," Barra says. "They're discovering the Internet from their phones." Xiaomi's edge, he says, is that it continuously produces new upgrades. "We build hardware, but we take a very software way of doing it. We do a software update every week!" These updates often incorporate the voluminous feedback that Xiaomi gets from its deeply involved fans: A single post by Xiaomi's team on the company's customer forums can receive 100,000 replies discussing the latest tweak to the operating system.

Indeed, Xiaomi's willingness to talk online with its customers has been a key part of both understanding the demands of young consumers and cultivating their manic devotion. Xiaomi sells its phones at close to cost; much of the company's revenue comes from its line of accessories, like headphones and step-tracker wristbands, as well as from app store purchases of things like new OS skins. The hope is that eventually even more revenue will come from the many ecommerce transactions that Xiaomi owners will engage in, buying everything from meals to plane tickets to clothing.

But to see the company's broader vision for the future, you need to head downstairs to a spare and elegant showroom. It's filled with Internet of Things devices that the company is bringing to market, all of which can be operated remotely via the mobile OS. There's a smart lightbulb, a connected webcam, a bathroom scale, a TV, a power strip—and an air purifier, a crucial appliance for the Chinese, who must contend with the country's out-of-

control air pollution. Once you buy one product, you'll very quickly buy the others, because they all work so well together, Barra boasts. "The game in China is building walled gardens and getting them to stay in your garden."

Xiaomi didn't design and manufacture this hardware itself. The executives went on a hunt for the country's hungriest cutting-edge startups, then invested in them and demanded they produce Apple-quality design. It is astonishing to see the ecosystem laid out. It makes Google's toe-dip into the Internet of Things—its Nest smart thermostat and security camera—look several years behind the curve.

China's creative generation, in other words, has proven it is ready to compete head-on with the world's top high tech brands. "Apple and Samsung are right to be worried," says Bunnie Huang, a well-known hardware hacker. (Indeed, Samsung's global share of the smartphone market dropped to 21.4 percent in the second quarter of 2015, from 32.2 percent in the same period of 2012.) When it comes to hardware, Chinese inventors benefit from proximity to the world's largest base of consumers, which is growing fast. Xiaomi's first major foreign expansion wasn't to the US but to the much huger—if poorer—India, where it sold 1 million phones in the third quarter of this year. Sew up China and India, it realized, and that's a third of the planet. In context, the US, where many consumers already own smartphones, isn't a particularly big market.

Yet while Chinese firms like Xiaomi are challenging the big tech firms, the flow of opportunity goes both ways: It's getting easier and easier for Western entrepreneurs to go work in China. They now regularly flock to hardware and software accelerators in the coastal cities so they can meet local collaborators or find factories. One French woman arrived in Shanghai last year to team up with Chinese coders and create an online market for French wine, targeting the chic restaurants where urbanites dine. Young American inventors congregate at H@xlr8r in Shenzhen, where they prototype everything from retro animated-GIF cameras to customized-pill-creation robots. China is essentially becoming a mecca, a destination for people with ideas—much as Silicon Valley did a generation ago.

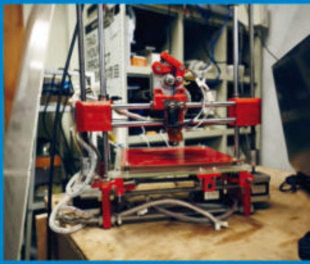
I saw that one day toward the end of my visit. I dropped by David Li's XinCheJian hackerspace, where Li was meeting with a startup team he'd been mentoring, including a Dutch-Italian man named Lionello Lunesu, who has lived in China for eight years, and a Latino man named Berni War. They were looking over their latest prototype, which had been sent by courier from a nearby factory. It was a little device that gives you alerts from your computer or phone, almost like an Apple Watch that sits on your desk instead of on your wrist. "For David, we're not going nearly fast enough," Lunesu says.

Li picked up the gadget and stroked its sleek white sides. "That's the same plastic they use for the iPhone 5c," he says. The entrepreneurs grin. A lot of this opportunity is not available in the US. That's why they're here.

CHINA'S CREATIVE GENERATION IS READY TO COMPETE WITH THE WORLD'S TOP HIGH TECH BRANDS.

XinCheJian cofounder David Li

A XinCheJian hackerspace in Shanghai



# A HISTORY OF VIOLENCE.

by
Arthur
Holland
Michel

The inside story of how a rogue weapons program created the new American way of war.

Bryan Derballa

# ON THE AFTERNOON OF OCTOBER 7, 2001, THE FIRST DAY OF THE WAR IN AFGHANISTAN,

an Air Force pilot named **SCOTT SWANSON** made history while sitting in a captain's chair designed for an RV. His contribution to posterity was to kill someone in a completely novel way.

In the moments leading up to the act, Swanson was nervous. He sat in a darkened trailer tucked behind a parking garage at CIA headquarters in Langley, Virginia, remotely piloting a Predator drone over Kandahar, 6,900 miles away. Nearly everything about his rig had been cobbled together and hastily assembled. The Predator itself, one of just a handful in existence, was flying about 250 pounds heavier than usual. And the satellite communications link that connected Swanson to the aircraft would periodically shut down due to a power issue, which software engineers in California were frantically trying to patch.

When the order came through to take the shot, Swanson pulled a trigger on his joystick. A little more than a second later, a Hellfire missile slid off an aluminum rail on the Predator's wing and sailed into the Afghan night.

Swanson's target was a pickup truck parked outside a compound thought to be hiding Mullah Omar, the supreme commander of the Taliban. The missile killed two unidentified men believed to have been his bodyguards. It was the first time a US drone had fired a weapon in combat. It was the first time a modern drone had ever killed a human being.

Fourteen years later, the drone is the quintessential weapon of the American military, which now boasts roughly a thousand Predator pilots. At any given moment, scores of them sit in darkened trailers around the country, staring at the bright infrared camera feeds from drones that might be flying over Afghanistan, Iraq, Syria, Pakistan, or Somalia. Between August 2014 and August 2015, a single Predator squadron—the 432nd Air Expeditionary Wing in Nevada—flew 4,300 sorties and dropped 1,000 warheads on ISIS targets. By enabling the White House to intervene without committing troops to battle, the drone has transformed US foreign policy.

Indeed, the national security establishment's embrace of the drone has been so complete, it's tempting to assume that this new paradigm of warfare was something dreamed up long ago by senior officials, who methodically plotted their way to it over a span of years and a string of defense contracts. That is, after all, how we got other major weapons like the M1 Abrams tank, the Apache helicopter, and the F-35 Joint Strike Fighter.

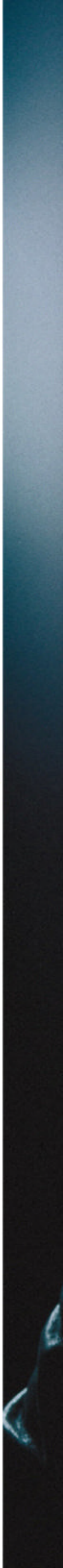
But that's not how we got the modern drone. The Predator as we know it—with its capacity to be piloted from thousands of miles away and its complement of Hellfire missiles—wasn't developed with the expectation that entire wars might one day be fought by pilots sitting in trailers. As a matter of fact, most military planners at the time regarded the Predator as pretty much a technological dead end.

The tiny team of engineers and operators behind the program, who rarely speak publicly about their roles as the architects of remote warfare, worked under intense pressure, almost entirely free from the scrutiny of Pentagon acquisitions officers. In a series of breakthrough hacks, they hot-wired together the lethal, remotely piloted Predator over the course of just a few months in 2000 and 2001, in a mad dash to meet the heinous design challenges of a single job: to kill Osama bin Laden before he could commit an act of terror greater than al Qaeda's bombing of the USS *Cole* in 2000.

The lethal Predator wasn't a production vehicle. It was a hot rod, built for one all-out race against the clock. Of course, in those months before September 11, 2001, none of its designers knew the nature of the clock they were racing against. And most Americans have no idea quite how close they came to beating it.

A

**America's first lethal** drone pilot was obsessed with flying from an early age. Growing up in Minnetonka, Minnesota, he joined the Civil Air Patrol at 13, got his private pilot's license at 18, and enrolled in the Air Force ROTC program at the University of Minnesota just after graduating from high school. During the first Gulf War, he flew UH-1 Iroquois "Huey" helicopters. After Iraq, Swanson became a special operations pilot, focusing on sensitive and



THE PILOT
Scott Swanson, a Minnesota-born Air Force captain, made the first-ever kill from a remotely operated drone 14 years ago.

THE CHIEF
Bill Grimes was head of Big Safari, the secretive Air Force skunkworks that transformed the early Predator from a motorized glider with a camera into a remote killing machine.

THE GODFATHER
"Marshall" was the Predator program's main advocate within the Pentagon, ushering it past administrative hurdles and helping put it in the hands of Big Safari.

covert missions. Whenever he was at home base, he would volunteer to help test new Air Force weapons.

In 1997, Swanson was coming up on the end of a two-year mission in Iceland, some details of which remain classified. ("The Icelandic women were amazing" is about as much as he'll volunteer.) Contemplating his next move, he searched a database of Air Force duty openings and found a curious posting that asked for rated pilots to join the Eleventh Reconnaissance Squadron at Indian Springs Air Force Base, near Las Vegas. The two-year assignment was to fly the Air Force's newest aircraft, a little-known bird called the Predator Unmanned Aerial Vehicle.

An avid reader of *Aviation Week*, Swanson already knew a bit about the unmanned aircraft. Hand-built by a small, idiosyncratic California startup called General Atomics Aeronautical Systems, it had been used in the Balkans for surveillance since 1995. But it was not well loved by the defense establishment. The Predator was unarmed, couldn't fly in bad weather, and could only be operated within a 500-mile range of the pilot. In 1997, an evaluation by the Defense Department found that it suffered mechanical failures in a staggering 12 percent of missions.

To most Air Force pilots, the idea of operating a drone would be a nonstarter. Pilots fly *in* planes. But Swanson had always been interested in tinkering, technology, and experimental weapons. (As a teenager, he once used a homemade batch of cellulose nitrate to fire a projectile through the door of an abandoned car.) And as a special operations pilot, he grasped the Predator's surveillance capability right away. "It kind of clicked," he says.

So Swanson signed up with the Eleventh, and before the year was out he was in Taszár, Hungary, flying surveillance drones over Bosnia on a four-month deployment—the beginning of a years-long career with the Predator.

It was also in Taszár that the Predator caught the eye of another figure who would be crucial in its development, a senior Defense Department officer who was among the first to recognize the aircraft's potential. This past spring, I made my way to the Pentagon to meet him. (For security reasons, he declined to be named.)

Sitting in his windowless office with a short public affairs staffer and a very tall security officer, the official—whom I'll call **MARSHALL**—told me about that first time he saw the Predator in action in Hungary. "I was blown away," he says. "It flies at 70 miles an hour with a TV camera, but it can stay there forever." Marshall could see that it represented a strategic breakthrough comparable to that of the World War II codebreakers at Bletchley Park. From then on, he became a Predator evangelist, providing political cover and money when the project faced a roadblock. As I looked around Marshall's office, I noticed several bottles of a wine called Predator Old Vine Zinfandel sitting on a bookshelf.

In 1998, Marshall helped see to it that the Predator program was handed over to a tiny outfit within the military that would essentially improvise the genesis of modern drone warfare: an entity known as Big Safari.

A

**A highly secretive** Air Force skunkworks based in Dayton, Ohio, Big Safari specialized in modifying standard Air Force aircraft for time-sensitive and highly classified operations, sometimes even for use in just a single mission. In 1961, for instance, when Nikita Khrushchev boasted that he was about to test the largest hydrogen bomb ever built, Big Safari had just five days to retrofit a Boeing KC-135 to carry a small lab's worth of sensing equipment—shored up with two-by-fours—to snoop on the enormous detonation.

"We generally didn't do anything from scratch," says retired colonel **BILL GRIMES**, Big Safari's director from 1985 to 2002. "We took existing hardware that was maybe for one purpose and adapted it to a completely different one for our needs." Like at a tech startup, Big Safari's teams were small and horizontal. Expediency, agility, and thrift were essential. "The most important thing was to get something useful to the war fighter quickly," Grimes says.

Big Safari set up its Predator office inside the General Atomics factory in San Diego, where the drone was made. And in the spring of 1999, during the Kosovo War, they got their first major chance to tinker with it. The Air Force came to Big Safari looking for a new way to steer laser-guided bombs dropped by jet fighters. US pilots wanted to stay above the range of Serbian antiaircraft fire, but their jets' laser designators—devices that beam pulses of light onto targets to guide missiles toward them—could not penetrate the region's heavy cloud cover. Big Safari's idea was to bolt a helicopter's laser designator onto a Predator. That way, the drone could stay below the clouds, in harm's way, and paint laser bull's-eyes on the ground for the jets high overhead.

In a typically lightning-fast turnaround, Big Safari had a modified Predator ready to be airlifted to the battlefield within 45 days. And its pilot—both in preliminary testing and on the ground in Kosovo—was none other than Scott Swanson.

Ordinarily, before a modified military aircraft is dispatched into combat, it has to pass through a lengthy vetting process that can take years. But Big Safari liked to deploy its creations before they were fully polished. The team referred to this as "the 80 percent solution" (because sometimes the last 20 percent of a job takes the longest). It was like releasing the beta version of a piece of software, says **BRIAN RADUENZ**,

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**ARTHUR HOLLAND MICHEL** (@writearthur) *is codirector of the Center for the Study of the Drone at Bard College.*

then the commander of Big Safari's Predator detachment. "We would need to get it out there, get it into the hands of the guys doing the job, and then pay close attention to what they had to say about how it was working."

The rest of the Air Force was naturally allergic to this approach. At one point, authorities at Air Combat Command—an entity that had jurisdiction over all the Air Force's Predators—ordered Grimes to relay all his communication with Predator test pilots through the command's headquarters in Virginia. Unwilling to play a game of telephone, Grimes just gave Swanson a secure line so he could report back to Big Safari on the sly.

In Kosovo itself, Swanson participated in just one strike before the war ended. But by then, the pilot and his colleagues at Big Safari could tell they were onto something; a drone that could pinpoint targets was no joke. "We knew it was the future," Swanson says. And that future was about to come at them in a rush.

## B

**Big Safari's work** on the Predator really took off when the group was enlisted in a high-stakes manhunt. In 1999, the CIA began to focus intently on Osama bin Laden, who had claimed responsibility for the US embassy bombings in Kenya and Tanzania in 1998. Intelligence reports indicated that bin Laden was planning further attacks. The agency wanted to put eyes on the al Qaeda leader and possibly target him, so it went looking for a covert way to get a high-powered camera over Afghanistan. The agency and the Pentagon considered several options, including a bizarre plan to mount a giant telescope on the side of a mountain. But after dispatching a group of officials in July 2000 to Indian Springs for a demonstration by Swanson, the CIA settled on the Predator.

First off, Big Safari had to figure out a way to sneak the Predator into Afghan airspace. Between maintenance crews, pilots, and field officers, it took several dozen people on the ground to sustain the operations of a single drone. According to Richard Whittle, whose book *Predator* authoritatively recounts the drone's history, the ground control station and satellite terminal were too large to conceal anywhere within a 500-mile radius of Kandahar. To make the operation truly covert, they would need to separate the drone from those controlling it by several thousand miles—by situating the command center at Ramstein Base in Germany. GINGER WALLACE, an Air Force intelligence officer who was assigned to work on the project, thought the idea was ludicrous. "There's no way," she remembers thinking. "We can't really do that."

The guy who figured out how to do exactly that—how to wage war from thousands of miles away with a few clever modifications—was known among his colleagues in Big Safari as the Man With Two Brains, for his freakish intelligence. Without him, Grimes tells me, "it would not have happened."

An independent contractor who started working on the Predator in 1994, the Man With Two Brains almost never gives interviews. He spoke on condition of strict anonymity. At the beginning of our conversation, which I was allowed to record with a pen and paper only, I was scanned with a small black device, for a wire.

The basic premise of his remote control system, called split operations, was simple. A small, covert team of General Atomics contractors would post up at an airfield somewhere in a country bordering Afghanistan (the location of the site remains classified). There, they would launch the drone using a traditional line-of-sight remote control link. Once the drone was airborne, an onboard antenna would connect to a commercial satellite, which would relay the link to the ground control station hidden inside Ramstein Air Base, where Swanson, Wallace, and the rest of the operations team—working in secrecy—would control the drone as it scanned the desolate Afghan desert for the CIA's target.

THE INTEL OFFICER
Ginger Wallace was a member of the team that operated the Predator on its first Afghan missions. She provided information about the landscape passing beneath the drone's camera feed.

THE TECHNICAL LEAD
Brian Raduenz led the small team that came up with all the modifications to Big Safari's Predator, from its laser weapons-guidance system to its customized Hellfire missiles.

True to Big Safari hacking tradition, the system did not require any significant new technology. But it did pose certain creative challenges. For instance, the plan required an antenna in Germany powerful enough to pick up a distant satellite signal—and the only option was a 36-foot "big-ass dish" located, appropriately enough, at Air Combat Command headquarters in Virginia. A team of contractors dismantled and made off with the satellite dish in a single night. By the time one of the lower-level staffers who managed the dish discovered it was gone and began circulating angry emails demanding its return, it was already en route to Germany, as were Swanson, some General Atomics contractors, and a joint CIA and Air Force operations team.

The team found what they were looking for during one of the Predator's very first split operations missions in early September 2000. Swanson was circling over Tarnak Farms, a walled compound near the Kandahar airport where bin Laden—or UBL as the team called him, referring to the alternative spelling, Usama—was thought to be living. Jeff Guay, an Air Force master sergeant on the team, was controlling the drone's camera. Sure enough, a man in white, surrounded by an entourage, soon emerged on their screens.

"When UBL walked out of that one building," Swanson says, "the way he appeared much taller than everybody, the people were deferential around him, the way he was dressed, Jeff and I just looked at each other and it's like, 'Yeah, that's got to be him.'" Swanson assumed a cruise missile would be dispatched in the direction of bin Laden while the Predator loitered overhead to make sure he stayed put. The team had been

Felix Petruška

instructed to continue circling for as long as necessary, even if that meant running out of fuel and crashing.

But for reasons obscure to the team, no strike was ordered. With Swanson gripping his joystick, unable to do anything but stare, America's final chance to kill BIN LADEN before September 11 slipped away.

THE TARGET Osama bin Laden, founder of al Qaeda, was the explicit target of Big Safari's efforts to turn the Predator into a remotely piloted weapon.

## I

**It was clear:** If the Predator had been armed, Swanson could have done the killing himself. And sure enough, the flight over Tarnak Farms kicked into high gear a project that had been quietly under way for months. Air Combat Command had decided to look into arming the Predator in 1999. When they put Big Safari on the case, Grimes convened a gathering of engineers and weapons specialists at the Big Safari office in Dayton. On the first day of what would become a two-day meeting, he noticed that some of the engineers were laughing at the proposition of mounting a missile on a motorized glider. "We identified those who were leaning forward, who felt like this could be done, and I privately got ahold of them and invited them the next day," he says. "The remainder were totally unaware of the second meeting."

Grimes and his team briefly considered packing the Predator with explosives and flying it directly into its targets, but a projectile that chugged along at highway speed was too slow to reliably surprise anyone. Big Safari needed a weapon that was small enough to fit on the Predator's delicate wings but powerful and precise enough to destroy a car or a person from high in the air.

Eventually they settled on the Hellfire, the Army's low-altitude, laser-guided helicopter missile. But the technical challenges of taking an antitank weapon designed to be fired from no higher than 2,000 feet and converting it into an antipersonnel missile that would be shot from above 10,000 feet were considerable. Among other things, the Predator would need a new forward-looking infrared camera, the team would need to recode the guidance systems on each missile, and someone was going to have to figure out how to give an armor-piercing munition the kind of grenade-like, shrapnel-spewing blast that would be effective at killing humans. "Even with a Big Safari mentality, that's a big-ass project to get done," Swanson says.

The team certainly didn't lack for motivation, however. In October 2000, just six weeks after the crew had first set eyes on bin Laden at Tarnak Farms, al Qaeda carried out its attack on the USS *Cole* in Yemen, killing 17 sailors. Big Safari had already proven it was possible to get a Predator within striking distance of the al Qaeda leader. Now their goal was to get a shot at him with an armed Predator before the next winter. When the CIA approved the idea of a lethal Predator and put its weight behind the program, the project went into overdrive. "You could see and tell with the energy of the team that you had a real no-shit goal with this," Swanson says. "We're gonna arm this thing and go hunting."

The Hellfire program's deadline was set for September 1, 2001. And everything was on schedule until a new roadblock shot up—a political problem that would inspire Big Safari's most historically significant technological hack.

In the summer of 2001, the German government decided that it would not permit the US to operate its newly armed Predators from Ramstein. So the CIA's deputy counterterrorism chief convened a briefing to announce that the effort to deploy an armed Predator to Afghanistan in search of bin Laden would be tabled until they could figure out somewhere else to base their operation. When the floor was opened for questions, the Man With Two Brains says, he raised his hand. He had an idea.

For years he had told Grimes and others at Big Safari that it would be technically feasible to operate Predator drones around the globe from within the US. He called his concept remote split operations. Now he realized that such a system wouldn't just make deployments easier, it would solve the agency's legal conundrum. The idea was to use the military's existing fiber-optic network to put 4,000 miles between the drone pilot, who would now be in the US—unaffected by Germany's laws—and the big-ass satellite dish, which would still be located at Ramstein.

This time, the challenges were technical: The Man With Two Brains had to find a way to package the various kinds of data traveling between the drone and the operators—flight commands in one direction, data from the camera and the drone's other sensors in the other—and shuttle them across the Atlantic without creating a lot of lag time.

To package the data, the Man With Two Brains turned to something called a multiplexer, a fairly cheap commercial device that Internet companies were using to bundle various kinds of files, like MPEGs, into fiber-optic-friendly packets for streaming. He split an encoding device in the Predator's existing satellite link system in two and placed each half on either end of the military's 4,000-mile undersea fiber-optic cable. Discarding a modem, he installed in its place two multiplexers, which encapsulated the data traveling in both directions.

Figuring out how to minimize lag time, or latency, was an equally devilish challenge. Anyone who has tried to have a conversation over a laggy Skype connection will have a sense of the problem. CIA and Air Force engineers had run their own calculations and determined that the new system would increase the total latency to five seconds, too much to safely operate a weapons system.

The Man With Two Brains wanted three months to complete the entire project; he got six weeks. Working in a lab in Washington, DC, the contractor spliced fiber-optic cables, soldered switchboards, and created a variety of loops and circuits that more resembled a Rube Goldberg machine than a device that would enable the killing of a human being from half a world away.

Once he completed the hack—on schedule—he traveled to Southern California to see how it would work on a real Predator. On the first day of flights, the remote split link passed various stress tests. **THE MAN WITH TWO BRAINS** planned to conduct further tests the next day—which was September 11, 2001.

T

**Time slowed down** for millions of Americans that morning, but for the Predator team it sped up. The remote split system was promptly approved for operation by the CIA; in Alabama, a batch of Big Safari's modified Hellfires was loaded into a transport pallet bound for Afghanistan; and Scott Swanson packed his bags for Langley, where the team's ground control station—the darkened trailer—was waiting by the CIA parking garage. Major **MARK COOTER**, the operation's director, started making calls to the other members of the group that had flown the Predator over Tarnak Farms, telling them it was time to get the band back together.

CIA electrical engineers had set up a sleek-looking control console in the team's trailer at Langley, but it didn't work, so Cooter instructed his own team to rip it out and replace it with a more functional setup, partly held together with zip ties and Velcro. On September 17, the team fired up the remote split link for the first time. Everyone watched as Swanson moved his joystick; 1.3 seconds later, the Predator responded. The addition of 4,000 miles of fiber-optic cable had increased latency by only 200 milliseconds, round-trip.

The 80 percent solution wasn't perfect, of course. "There were glitches," Swanson says. The data link, which shared a satellite with several cable television networks, would drop out unexpectedly, as happened on October 7, when a white-knuckled Swanson killed Mullah Omar's two presumed bodyguards. During another strike, the Predator's communications system went into a reboot at the precise moment Swanson launched one of its Hellfires at a radar site. In the first three months of the war, the team lost at least two Predators due to malfunctions. "Oh yeah, it was a duct tape war," Marshall says.

Bit by bit, the team racked up some early successes, including a strike that killed Mohammed Atef, the military commander of al Qaeda. Word of their exploits spread, and elite forces on the ground would specifically request air support from the Predator team, which had been given the codename Wildfire. The team framed a copy of a 2000 Defense Department report that had declared the Predator a failure and hung it on a wall next to a list of what Marshall called their greatest hits. That October, an unnamed official said in a Pentagon briefing that theater commanders were "begging for more Predators." In a December 2001 speech, then-president George W. Bush singled out the Predator as a harbinger of the military's future. "It is clear the military does not have enough unmanned vehicles," he said. In the space of three years, Big Safari had transformed an albatross on the verge of extinction into a lethal bird that was now being hailed as the chief weapon in the War on Terror.

And they kept hacking. Using consumer electronics, the Man With Two Brains figured out how to transmit the Predator's live feed to AC-130 gunships and, later, to ground forces. The team even figured out how to channel a cable television feed into the Predator's video dissemination system, essentially turning the drone into a flying TV antenna: That way, forward-operating Special Ops teams could watch NFL games and movies during their downtime.

THE GENIUS
The Man With Two Brains, as colleagues nicknamed him, conceived the remote control system that enabled drones to be operated from thousands of miles away.

THE OPS DIRECTOR
Mark Cooter helped direct the first secret missions that sent the drone over Afghanistan.

S

**Swanson, who now** works as a consultant out of Antigua, Guatemala, has a stiff crop of red hair that turns to gray at the sideburns. His eyes are small and intense, and he chooses his words with the concentration of someone who knows a lot of secrets.

Today the Big Safari team members don't have much to do with the Predator. They're mainly retired or doing other things, while the national security establishment that once disparaged the drone has thoroughly embraced it. The Predator has ushered in a more precise era of warfare. It has also inspired new kinds of nightmares for those who live under drones—and those who fly them.

In the summer, Swanson Skypes me from Antigua. During those first missions, he says, he was struck by the intimacy of this new form of warfare. "You're watching these people coming and going," he says. "You're watching them go out and take dumps or pees in the middle of the night.

"I'm not saying you ever really bond with the target," he goes on. But you dwell on them for dramatically longer than with any other weapons system, he says. His pauses begin to draw out.

I ask how it feels to have participated in the creation of the Predator. He mentions a recent drone strike that killed Nasir al-Wuhayshi, al Qaeda's second-in-command. "I feel proud to have been part of the team that brought that forward," he says.

What about when a strike misses its target or is used for ill? That has less to do with what the Predator can and cannot do, he says. "That is just the ugly nature of war. And yeah, there's always a little twinge of regret with that." Swanson pauses again. "The world is not black-and-white," he says. "It's shades of gray presented to you in an infrared image."

A father, a dying son, and the quest to build the most profound videogame ever.

by Jason Tanz

# Playing for Time

# You find yourself in a hotel room in a strange city, like a character in the first scene of a videogame.

Take a second to get oriented, to remember where fate has delivered you. Seattle. OK. You have come here to meet Ryan Green, who has made a videogame about his young son Joel's battle with brain cancer. You're not sure you're ready for this, but you don't have much choice. Deep breath. Go.

Head down to the lobby. Walk outside and travel two blocks northeast to the Washington State Convention Center, which is currently hosting PAX Prime, the country's largest annual videogame expo. Enter the convention center and locate the escalator, just there, up the stairs to the left. Ascend to the fourth floor. Walk past the long lines of gamers waiting to take a spin through forthcoming big-budget releases like *Tom Clancy's The Division* and *Mad Max*. Work your way back to the Indie Megabooth, a collection of more than 70 independently developed, artsier titles. There is a map; find the game you're looking for, *That Dragon, Cancer,* tucked away in the northeast corner. As you reach the booth, notice the poster—a digital sketch of a large man in a hospital chair cradling a small boy, an IV delivering a toxic green fluid into the child's body.

Green showed a demo of his game here in 2013, and you've heard the stories. Players breaking down in sobs and quickly exiting the booth. The emergency box of Kleenex, hastily procured and placed next to the monitors. The soothing reassurances to distraught gamers that Joel was, in fact, still alive.

Enter the booth. There are two monitors on a table. Players sit before them, silently steering through the latest demo. Here is what they see: a young boy, his facial features obscured, feeding bread crumbs to a duck, while his parents explain to his brothers why his treatment has left him unable to speak at age 2; a man sitting at a picnic table, ruminating on what his son must be experiencing without the words to express it; a playground, where the boy rocks on a toy horse, swings, giggles, spins on a carousel, then disappears; a path to a beach, where the boy is now strapped to a gurney, his tiny body hooked up to machines, the water filled with bobbing, gnarled tumors; the shadow of a dragon against the sea; a flight through the window of a hospital; a doctor telling the family that a recent MRI shows the boy's tumors have returned; a nurse assuring them that the staff is very good at end-of-life care; the boy's parents sitting still and silent while the room fills with water; the boy, now sitting in a rowboat, wearing a tiny life jacket that doesn't look sufficient to protect him.

You know you will have to play this game at some point. You will have to confront all of these moments, and many more. But not yet. Instead, you find the bespectacled man wearing a narrow-brimmed straw fedora and a close-cut red beard. This is Ryan Green. Hold out your hand and share a sad smile, a silent acknowledgment of what you both know—what Green himself didn't know when he started working on *That Dragon, Cancer,* what he didn't know the first time he brought it here to PAX. You know how the game ends. You know that Joel dies.

Photographs by Elinor Carucci

**Green began working** on *That Dragon, Cancer* in November 2012. Joel, who had been diagnosed with a rare and aggressive form of cancer just after his first birthday, was approaching the age of 4. Green and his wife, Amy, lifelong devout Christians, saw this longevity as a miracle; back in November 2010, when Joel developed a new tumor after several rounds of chemotherapy, the doctors had declared him terminal, placed him on palliative care, and given him at most four months to live. The Greens had spent much of the next two years celebrating small victories and enduring crushing setbacks. Tumors that shrank, or even disappeared, then reemerged with greater vigor months later. Steroids that filled Joel with a powerful rage. A tumor that pressed on Joel's optic nerve, causing his right eye to turn inward.

Green's idea to make a videogame about Joel came to him in church, as he reflected on a harrowing evening a couple of years earlier when Joel

“We’d love for the game to impact people and for it to be commercially successful,” says Amy Green, shown here with her husband, Ryan. “But there’s a piece of me that says, maybe it’s just for us.”

was dehydrated and diarrheal, unable to drink anything without vomiting it back up, feverish, howling, and inconsolable, no matter how Green tried to soothe him. He had made a few games since then and had been thinking about mechanics, the rules that govern how a player interacts with and influences the action on the screen. “There’s a process you develop as a parent to keep your child from crying, and that night I couldn’t calm Joel,” Green says. “It made me think, ‘This is like a game where the mechanics are subverted and don’t work.’ ”

Green—along with Josh Larson, his codesigner—built a scene around that idea, and in early 2013 they started bringing it to videogame expos to drum up interest. Players found themselves in a hospital room with Ryan, clicking the walls and furniture in search of some way to relieve Joel’s suffering and quiet his screams. Yet every action—rock him, bounce him, feed him—only caused the crying to intensify. On the soundtrack, Green’s voice grew increasingly frantic until, pushed to the edge of despair, he broke down in prayer, at which point the scene ended.

The compelling demo made *That Dragon, Cancer* a cause célèbre within the indie game community. Noted game writer Jenn Frank played it at that year’s Game Developers Conference in San Francisco and wrote a raw essay about the thoughts and feelings around her own mother’s death that it evoked: “We will all meet this thing, or have already met it,” she wrote. “Maybe that should be scary, but *That Dragon, Cancer* is about sustaining the hope and joy of life for just as long as we can.”

Other influential raves soon followed. “I don’t know what else I will remember about this show, which things are going to stick, but this one has already set up shop,” PAX co-organizer Mike Krahulik wrote on his blog that same year. Green, he continued, “has encoded the experience, his actual experience, of being a father to a son doctors tell you will not and cannot live. It is an act of incredible bravery to collect it at this level of emotional ‘resolution,’ and we talked for as long as I could possibly spare about what it is to be a believer in God in the world we have been given.”

The game’s reputation has only grown since then, building anticipation for its January release on the Ouya console and for the Mac and PC on the Steam platform. *That Dragon, Cancer* has been written up in *The Wall Street Journal*, *Forbes*, and *The New York Times*. A documentary about the game, *Thank You for Playing*, screened at the Tribeca Film Festival and will air on PBS in 2016. (The film was codirected by Malika Zouhali-Worrall, the wife of my WIRED colleague Andy Greenberg.) “*That Dragon, Cancer* is an amazing work of art,” says prominent game theorist Raph Koster. “In some ways, I’m glad that games were there for Ryan, because it sounds to me like the kind of questions that he is wrestling with, games are the right medium to wrestle with them in.”

Amidst all the plasma guns and power-ups, it can be easy to overlook the fact that videogames are inherently metaphysical exercises. Designing one is like beta testing a universe. Its creators encode it with algorithms, maps, and decision trees, then invite players to decipher its hidden logic. Intentionally or not, games contain implicit messages about purpose, free will, the afterlife. Master the secret rhythms of *Super Mario Bros.* and you can deliver the eponymous plumber to a princely paradise. But even the best *Space Invaders* player is fated to end the game in defeat, another futile circuit in its samsara-like cycle of death and rebirth.

In a 2011 lecture titled "Truth in Game Design," developer Jonathan Blow declared that games were a unique platform through which to explore the mysteries of the universe. "We can come to the game with question after question after question and type in some code and get answer after answer after answer," he said. "And if we're tapping into the right thing, then the volume of answers available to us can actually be quite large." Blow, whose time-bending puzzle game *Braid* was a breakout hit, was speaking mostly of questions pertaining to theoretical physics and advanced mathematics. The questions *That Dragon, Cancer* is asking, on the other hand, are the kind of spiritual and existential quandaries that have haunted humanity since Job: Why are we here? Can we influence our fate? What kind of God would allow such suffering? How do we endure the knowledge that we, along with everyone we have ever met and loved, will die?

Unlike the games in Blow's lecture, *That Dragon, Cancer* doesn't provide any solutions to its queries. "A lot of people say art asks questions, and that always bothered me. Why leave people with just questions?" Green says. "But I find, through this process, that I do have more questions than I did, and I'm not so keen or eager to offer answers."

Toward the end of *Thank You for Playing*, the documentary about the game, there's a scene in which you can spy a copy of *Reality Is Broken* on the Greens' bookshelf. The manifesto, by designer and academic Jane McGonigal, argues that we should engineer our world to be more like a videogame, incorporating its system of rewards and escalating challenges to help us find meaning and accomplishment in our lives. Green, though, is doing the opposite. He's trying to create a game in which meaning is ambiguous and accomplishments are fleeting. He is making a game that is as broken—as confounding, unresolved, and tragically beautiful—as the world itself.

**They wait somberly** in line: cosplayers, young women, middle-aged men. They sit in front of the monitor, put on the Bose noise-canceling headphones, and pick up the Xbox controller. Fifteen minutes later they stand and push back from the table. Many of them affect sheepish grins, rise quietly, walk off abruptly without making eye contact. A few get misty-eyed, clearly shaken, collecting themselves before they leave. And then there's the developer who starts weeping and says, "I don't want to be here at PAX; I want to be home with my kids." The couple whose own daughter survived cancer and who have followed the game's development for years. The boy who staggers away from the screen as if emerging from a particularly punishing roller coaster.

"Are you OK?" Green asks.

"It's just so *sad*," the boy says in a hushed tone, staring off. He wanders away, dazed. A few minutes later he returns to collect the backpack he has inadvertently left behind.

Green, on the other hand, doesn't at this moment appear particularly haunted or upset. He stands in front of his booth with the studied casualness of someone who knows that people nearby are talking about him. His burly figure would be imposing if he weren't dressed in cargo shorts and flip-flops, a wardrobe that—along with his sunny, authoritative

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*Editor at large* **JASON TANZ** (@jasontanz) *wrote about Salman Khan and his new lab school in issue 23.11.*

Below: a scene from *That Dragon, Cancer*

**_That Dragon, Cancer_ explores spiritual and existential quandaries that have haunted humanity since Job.**

demeanor—gives him the air of a summer camp director. Despite the circumstances, he is happy to be here.

An experienced programmer, Green is relatively new to the indie-game world. Until recently, he worked full time designing software for a Denver-based dialysis company, a job he held for 11 years. In 2008, just before Joel was born, Green, who had long dabbled in filmmaking, poetry, and art, decided to try his hand at game-making. He spent his evenings and weekends learning how to use the Torque game engine and cranking out silly iPhone trifles with names like *Sir Roly Poly* and *Little Piñata*. They didn't sell well, but Green enjoyed making them. He had always fantasized about pursuing a creative career, and he and Amy hatched a plan to save up enough money for him to quit his job after a few years and build games full time.

When the Greens received Joel's first cancer diagnosis in January 2010, that creative outlet became more important to Ryan, even as it grew more difficult for him to pursue. The Greens live in Loveland, Colorado, about an hour from Joel's oncologists in Denver, and Ryan found his schedule overtaken by late-night trips to the emergency room and overnight stays in the ICU, wrestling with feeding tubes and chemotherapy pills, juggling childcare for the Greens' other children, and all the other logistical, emotional, and psychological challenges that come with tending to a seriously sick child. Ryan's boss told him to take as much time as he needed, and he ratcheted back to working about 30 hours a week. At the same time, he found himself taking on contract game-design work, something to keep him creatively engaged during those long and terrifying months.

Then, just under a year later, Joel was declared terminal. The news caused Green to reassess his life. The dialysis company was giving him paid time off and the flexibility to take care of his family, and he was using it to work for somebody else. He was one month away from a $30,000 retention bonus—money that was crucial to his plan to strike out on his own—but he couldn't stomach the idea of accepting it under such pretenses. Over the protests of his employer, he quit.

"Everybody around me was like, 'Don't fall on your sword, you don't have to do this,'" Green says. "I don't want it to sound more noble than it was, but it just felt like a moment where I could have some integrity."

"You think, 'Ugh, I kind of hate this, but I get it,'" Amy says. "Both of us at that point were like, 'Let's do what you're passionate about and not just get through life. Let's make decisions we love.'"

For Green, that meant making games that explored religious themes. He started doing full-time contract work for Soma Games, a Newberg, Oregon–based developer of Christian videogames. In late 2010 he met Larson, an indie-game veteran from Des Moines, Iowa. Larson, another devoted Christian, had been spending time on a "not-games" forum, an online discussion for developers interested in avoiding all the usual gamelike trappings—the puzzles and quests and levels—to discover what else the medium might be capable of. *I Wish I Were the Moon* was a clickable tone poem about lost love. *Proteus* had players wander around an interactive landscape. Larson says his interest in not-games was purely intellectual, not spiritual, but the effort to move beyond performance-based reward systems seems to track with some of his deeply held philosophical beliefs. "The idea of grace is that you don't have to do something good to earn your salvation," he says. "People are always so concerned about what you do in a game, and they can be that way about life too. Whereas some people, depending on what kind of faith they have or what kind of person they are, that's not necessarily what defines them."

Green and Larson cemented their friendship during a 2011 game jam Larson organized to promote the development of what he called "meaningful games." At Amy's suggestion, Ryan created *Giga Wife*, a simple, Tamagotchi-like game in which players pushed buttons to deliver romantic gestures to their virtual spouses. In an explanatory essay, he underscored the importance of marital mindfulness, confessing that he too frequently took Amy for granted. "Most of my life has been spent taking and pursuing my desires, in contrast to giving and seeking hers," he wrote. "I tell her I love her every day. But I'm not sure I always do it for her. Sometimes I do it out of duty." For his part, Larson made a game based on the philosophy of Molinism, which theorizes that God accounts for free will by knowing how we will respond to certain conditions, then reverse-engineering the world to create those conditions. In Larson's game, players had to design an environment that compelled an onscreen character to trip over a log and land next to a butterfly, thereby sparking a lifelong passion for lepidopterology.

Soon the duo began talking about working together. After tossing around a few ideas, Green suggested making a game about Joel. Larson was instantly enthusiastic. "We both felt compelled to do it," Green says now. In fall 2012, Larson announced to Green that he would forgo all of his contract work and live off his savings for a year to work on the game.

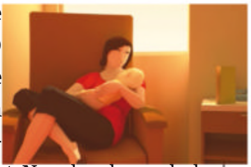
"He said, 'I feel an urgency in my spirit. I think you're supposed to do this and do this now, and I want to help you,'" Amy says. "Who does that? They knew each other and worked together, but it wasn't like they were best friends. It was just unbelievable."

The Greens took a hard look at their own finances and decided they could afford for Ryan to set aside his contract work as well and spend three months working on *That Dragon, Cancer*. But when that time was up, Amy couldn't bring herself to ask him to return to work. "I remember thinking, 'This is the most foolish thing I've ever done,'" she says. "Living off our savings until we have nothing left—you can't do that with a kid who's dying. You can't do that in general! But I had that conviction that I needed to let him do this."

By early 2013, Green and Larson began showing scenes from the game to potential funders—an urgent need, as by this point the Greens had burned through their savings and were living off donations and loans from friends.

**The videogame became Green's primary method of dealing with Joel's illness, as well as his connection to a son he struggled to understand.**

One of their first meetings was with Kellee Santiago, an old acquaintance of Larson's who was leading developer outreach for the Kickstarter-funded Ouya console. Santiago had previously cofounded Thatgamecompany, creator of the art-house crossover hits *Flower* and *Journey*, and she was immediately drawn to Green and Larson's project. "Five minutes into it, in my mind I was canceling all my meetings, because I wanted to spend as much time as I needed to talk them through this," she says. Santiago eventually agreed to fund the project, giving Green and Larson enough money not only to support themselves but to hire three more developers to work on it with them. (The money, along with some other grants, lasted through November 2014, at which point the team raised more than $100,000 on Kickstarter to complete the game.)



Green was accustomed to transmogrifying his life into art. He and Amy had already made a short film based on their experiences with Joel and had self-published a children's book titled *He's Not Dead Yet*. Now he channeled his frustration, fear, love, and hope into designing a series of interactive challenges. One preliminary idea had players struggling to insert a feeding tube into Joel's nose. Another, called "Auto-Tune the Noise," poked fun at the barrage of well-meaning advice—Have you tried oxygen therapy? Have you tried cutting out sugar?—that they'd received over the years. Green wrote a minigame in which players could shoot at targets that represented the terrible decisions he and Amy were forced to make—whether to undergo another round of radiation despite the damage it might do to Joel's spinal column, whether to give Joel antiseizure medicine that might cause peripheral blindness.

Over time, *That Dragon, Cancer* became Green's primary method of dealing with Joel's illness, as well as a way for him to preserve a connection to his son, whom he struggled to get to know. In real life, Joel couldn't talk about his feelings, leaving Green to guess at his thoughts and emotions. Joel's reaction to radiation therapy was particularly puzzling. Children usually hated being placed on the gurney inside the giant linear accelerator, resisted the anesthetic, fought and clawed at their parents and doctors every time they entered the room. But Joel loved it. He grew impatient in the waiting room, and his face lit up when the doctors came to get him, more excited than his parents had ever seen him. Green couldn't know just why Joel was so enthusiastic about undergoing the anesthesia, but he wrote a scene imagining the adventures Joel might be experiencing in his mind—riding animals made of stars, giggling and tearing across the cosmos.

According to Green's original design, the game would end with you, the player, facing an array of dozens of levers. For a while you would yank and tug at them, trying to discern the pattern that would unlock the game's conclusion. After a few minutes, the camera would pan up to reveal the back of the console, its wires frayed and disconnected. The levers were false, the game's designer was in charge, and you were forced to acknowledge that you were powerless to control the outcome.

That conclusion arose directly from the Greens' religion, their belief that God's will was beyond human comprehension, that we are operating within a divine plan that we may or may not have the power to influence. Even as they pursued every medical option, their agony was somewhat relieved by the conviction that Joel's fate was ultimately in God's hands. "With God we don't have to do the right things or say the right things to somehow 'earn' his healing," Amy wrote in an online diary soon after Joel's first biopsy. As Ryan worked on his game, the Greens continued to believe they were on the cusp of a miracle: Joel's survival and recuperation in spite of all medical science.

But then, toward the end of 2013, Joel developed a new tumor near his brain stem, and his health began deteriorating quickly. He struggled to maintain his balance. His right eye turned more noticeably inward. He began experiencing seizures and difficulty swallowing. In January 2014, Joel's oncologists told his parents that the tumor was untreatable. The Greens traveled to San Francisco to take part in a Phase I experimental trial of a new drug, but it was unsuccessful. On March 12, 2014, on the recommendation of their hospice nurse, the Greens took out the feeding tube that was Joel's only source of sustenance. That night, they hosted an evening of prayer and song at their home. At 1:52 am on March 13, Joel died in his parents' bed, with Ryan and Amy by his side.

The team had discussed how they might finish the game after Joel's death, in case Green had to take a few months off to grieve. But two days after the funeral he was ready to get back to work. If anything, the game felt more crucial than ever. It had been written when Joel's death was hypothetical; now, in the shadow of the actual event, much of it seemed irrelevant or off-base. The final, lever-pulling scene came to feel particularly unsatisfying. Joel's death may have been a manifestation of God's unknowable will, but Green found himself unable to accept it, as the scene encouraged players to do. Over the course of the next several months, the team decided to rewrite 70 percent of the game, de-emphasizing Ryan and Amy's experience and focusing instead on scenes that directly involved Joel—caring for him, playing with him, attending to him.

Working on the game also gave Green an important outlet, a way to explore his grief and keep his son alive in his memory. In one of our first conversations, he seemed startled to realize that he and Amy hadn't read many books or attended any support groups or counseling sessions to help them process their loss. "I've used this game as a way of wrestling with it," he says, "more than the typical channels of grief."

"Ryan was able to spend the last year of Joel's life, and all of the time since he died, working on this game," Amy says. "We'd love for it to impact people and for it to be commercially successful. But there's a piece of me that says, maybe it's just for us."

Josh Larson quit work and lived off his savings to devote himself full time to making *That Dragon, Cancer*. “We both felt compelled to do it,” Green says.

T**he Greens—Ryan, Amy,** and their four children—live in a small townhouse about halfway between Loveland’s big-box commercial district and its sleepy, red-brick downtown. Their home and schedule reflect a laissez-faire approach to time and space management. The shelves and walls are cluttered with family photos, paintings, figurines of a man and woman cradling a baby. A stack of board games towers atop the refrigerator. Two beat-up Xbox consoles inhabit the entertainment center.

On a sun-blasted September afternoon, I pull up a chair in front of their TV. Green takes a seat next to me. Larson, who has flown in to work on the game for a few days, settles into an easy chair. Amy is here too, sitting next to Jon Hillman, a local composer who signed on as the game’s sound designer after meeting Green at a coffee shop. The game’s two other far-flung designers, Ryan Cousins and Brock Henderson, are waiting to discuss my experience via Google Hangouts. Green smiles and hands me an Xbox controller. I am about to become the first person outside the core development team to play a full run-through of *That Dragon, Cancer*.

I am not a great player of videogames. I get disoriented easily, I am quickly overwhelmed by complicated button combinations, and I often pass right over the clues and prompts that designers use to nudge players through the story.

But *That Dragon, Cancer* is not a tricky game to master. Indeed, it’s barely a game at all, more a collection of scenarios that the player explores and clicks through. There is some degree of agency—you can decide how long to spend in any particular scene, for instance—but the overwhelming sensation is one of being a bug caught in a rushing river; you might veer a few degrees in either direction, but you can’t alter the overall flow.

All videogames are deterministic; some just mask it better than others. The *Super Mario Bros.* series may give the appearance of serendipity, but creator Shigeru Miyamoto planned every surprise down to the pixel, a kind of 8-bit *Truman Show* of false autonomy. For all their free-range chaos, the massively multiplayer games of the ’90s and ’00s were ruled by “gods” and “immortals”—admins who could spy on players, take control of their avatars, or single-handedly wipe objects out of existence. Today, many of the most popular cinematic titles hew to what Koster calls the “string of pearls” design: lots of freedom within individual levels, but a rigid structure that ultimately forces the player’s hand. “You have all the choices in the world, until you have to move on and do what they tell you,” he says.

In his recent book *God in the Machine: Video Games as Spiritual Pursuit*, Liel Liebovitz, an assistant professor at NYU, argues that such contradictions are inherent to gaming, part of what makes them fun and meaningful. “To be coherent,” he writes, “to be compelling, video games must unfold in a way that allows players to continue and believe that the decisions they make are their own, and that the game’s world, preordained as it is, nonetheless allows for expressions of their free will. Video games, in other words, depend much on the sentiment expressed by the Jewish sage Rabbi Akiva, in *Pirkei Avot*: ‘Everything is foreseen, and permission is granted.’ ”

But some game designers have taken the opposite approach, calling attention to players’ fundamentally powerless position. The 2007 blockbuster *BioShock* put players in the role of a vengeful amnesiac who learns in a cli-

The Green family relaxes at home in Loveland, Colorado. Ryan recorded his eldest sons' voices for the soundtrack of *That Dragon, Cancer*.

mactic scene that his seemingly independent actions have been programmed, *Manchurian Candidate*–style, by the game's villain—just as the player's own actions had been programmed by the game's creators. In the comic meditation *The Stanley Parable*, a hapless office worker explores his abandoned workplace while being harangued by the game's domineering narrator, who grows more flustered and hostile with every act of disobedience. But each seeming transgression—going through the door on the right instead of the suggested door on the left, for instance—is undercut by the realization that it's all part of the game's inescapable design.

The 2012 cult hit *Dear Esther* pushes in an even more radical direction, removing every pretense of autonomy. In the game, players follow a path around a deserted island. As they hike inexorably to a tragic conclusion, they hear snippets of a deranged man's letters to his dead wife. The messages are delivered semi-randomly; it takes seven or eight playthroughs to listen to all of them. But even then, the story remains ambiguous, never completely explaining who the characters are or how they intersect. The result is a profound irony. While players can't influence the game itself, they are in many ways granted a more meaningful freedom: to interpret its creators' inscrutable logic. People went online to share their outlandish theories, a fact that tickled the game's designer, Dan Pinchbeck. "This thing is so out of our control, in a way," he told an interviewer at IndieGames.com. "That's a really lovely feeling."

*That Dragon, Cancer* is very much in the *Dear Esther* mold, pulling players through an evocative landscape whose meaning proves elusive. It's not even clear what character you inhabit—sometimes you're Green, sometimes you're a bird, sometimes you have no body at all but hover above the action, watching from a benevolent remove. Sometimes you interact with the characters onscreen—as when you cavort in a playground with Joel—and sometimes you manipulate them, as if you've entered their bodies.

Green, Larson, and the rest of the team monitor my play closely. Do I realize I'm supposed to follow that sweep of light down to the waterfront? Did I find the cell phone that unlocks the next stage of the game? What did I think that wing-flapping sound indicated? Did I understand why that blue van was parked under the lighthouse?

For the most part, I move easily through the game, but I get stumped halfway through. Ryan is drowning, curled shrimplike in the middle of a vast sea, a portrait of helplessness and despair. Looking up I see a slightly damaged life preserver on the surface of the water. I realize that, by steering the pointer near Ryan's body and pressing a button, I can get him to swim. But when I guide him to the surface, I can't get him out of the water. He sputters and gasps but won't grab the life preserver. I keep trying—five, six, seven times. Green, sitting next to me, stares at me meaningfully.

"I think I need some help," I say.

Green pauses. He doesn't want to tell me what to do, but he's willing to give me some ambiguous guidance. "Well," he says, "what can you do other than swim up?"

That's when I notice the light, glowing up from the bottom of the sea. I reorient my pointer and urge Ryan down. It takes a long time, so long that at one point I'm convinced I've hit another dead end and give up. But it turns out I just haven't gone far enough. Eventually, after swimming for a few more seconds, I reach the bottom and the scene ends.

We all sit in silence for a moment, and then I hear Amy stirring behind me. "It shouldn't be that hard," she says. "You're making them go down awfully far."

Ryan grins, a little sadly. "Yeah," he says, "I am."

**BY TURNING HIS** personal loss into art, Green has also been able to convert his grief into labor. At times, that's a gift—when he's designing a landscape or animating a character's movement, he can almost lose sight of the larger story. But occasionally he'll be crippled by the enormity of what he's grappling with. Once, he says, he broke down sobbing while positioning images of himself and Joel on a hospital bed. Cousins, the designer, told me that he sometimes hesitated before sending Green new animations of his son, for fear it might be overwhelming. Larson sometimes has to take extended breaks, particularly when he's doing speed-runs—high-velocity run-throughs of the entire game—experiencing Joel's decline over and over again.

In a way, the process of working on the game in the months since Joel's death has given Green the opportunity to spend more time with his son—or at least a digital approximation of him, what Green calls an "echo" of who Joel used to be. "If I look at the game objectively," Amy says, "of course it's all just to make his life matter. You wanted his life to matter so much, and he died young, and in a lot of ways his life will only matter if we make it matter. When the project is done, that process ends. And then we get to see, does this matter?"

Toward the end of the run-through, I enter a giant cathedral. This is the scene that Green has worked on most diligently since Joel's death. It replaces the lever-pulling scene, his initial idea to urge the player toward accepting his own powerlessness. This is the scene, Green says, that embodies all the wrestling with God he has endured since his son's death, the scene that once provided answers but now leaves only questions. I brace myself.

"This isn't quite done yet," Green says. "I'd better walk you through it."

I exhale and sit back as he takes the controller. A wave washes over me. It feels like relief. It's no longer my job to navigate this treacherous emotional landscape. All I have to do now is put myself in the designer's hands.

**SETTLE INTO YOUR CHAIR.** Turn to your left. There is Ryan Green, his hands on the Xbox controller, his eyes focused on the screen. Face forward and watch the game. Your view swings around the cathedral, awe-inspiring in its size but clearly under construction. You see scaffolding, an unfinished stained glass window. Now the picture swings around again and you are looking at the altar, and there is Joel. He looks impossibly small inside this vast expanse. Behind him, Jumbotrons recapitulate and magnify his image.

Green continues to move you through the cathedral until you find a spot about 20 rows back from the altar. Soon, the church fills with the sound of prayer. These are the actual prayers that Ryan, Amy, and their friends sang and whispered and screamed the last night of Joel's life, prayers that were not answered. "*Please!*" you hear a voice bellow. "*Return this boy's soul to his body!*"

In two days, you will fly back to your family. At some point in the future, hopefully long into the future, you will say good-bye to them. You will leave them, or they will leave you. You may be able to influence how or when this happens, but you cannot change the fact that it will happen. You also cannot change the fact that whoever remains will feel great pain, will ask difficult questions, and most likely will not receive satisfactory answers. It may bring to mind the words of the theologian C. S. Lewis, who inadvertently wrote about grief as something akin to a dark, final level in a videogame, the miserable reward for succeeding at love, "as if God said, 'Good: You have mastered that exercise. I am very pleased with it. And now you are ready to go on to the next.'" When you read those words, months from now, they will remind you of something Amy Green once told you: "Pain doesn't mean you failed. Suffering doesn't mean you failed. In a strange way, I think suffering may mean you won."

But for now, sit here, in the Green family living room. The cathedral scene is over, but Ryan does not offer you the controller back and you do not ask for it. Joel is back on the screen, but now he is healthy and happy. The room fills with his laughter—his actual laughter, recorded before he died. Ryan pushes a few buttons and makes Joel laugh harder. Don't look directly at Ryan. Stare straight ahead, but note that you can still see him, hazily, in your peripheral vision. Take him in, watch him there, crying and smiling, playing with his creation on the other side of the screen.

# COLOPHON

### LIFESAVERS THAT HELPED GET THIS ISSUE OUT:

Lots of wine; 3 pm snacks; all-wheel drive on Donner Pass (no cannibalism necessary); Destiny's Child circa 2001; Chuckolate; my dad, who is capable of making electrician service calls via FaceTime; a frosty shot of Wilder gin with a generous splash of tonic and a thin-skinned lime; a $20 space heater; full-fat cheeses; the unbelievable selection of Cascadian and French black metal on Spotify; USS *Hornet*; Aaron and Jennifer of Appleton Avenue; vjoon K4; Croatian lemon cookies; 150 new emoji; fellow joggers on the Embarcadero keeping me motivated #peerpressure; GitHub; the paper clip that fixed my wardrobe malfunction; Bulleit; Saxum.

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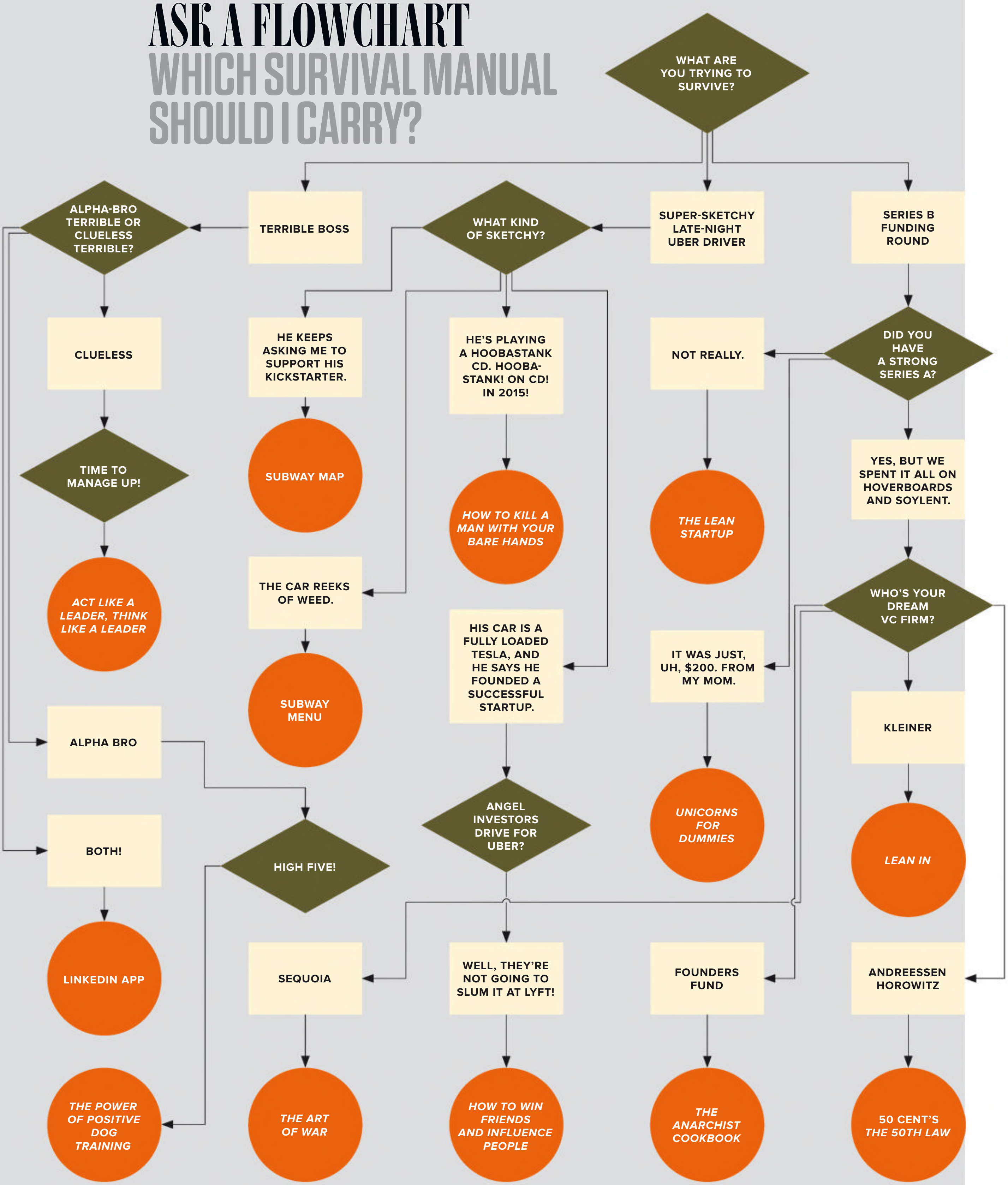
BY ROBERT CAPPS

# ASK A FLOWCHART
## WHICH SURVIVAL MANUAL SHOULD I CARRY?



- WHAT ARE YOU TRYING TO SURVIVE?
  - TERRIBLE BOSS
    - ALPHA-BRO TERRIBLE OR CLUELESS TERRIBLE?
      - CLUELESS
        - TIME TO MANAGE UP!
          - *ACT LIKE A LEADER, THINK LIKE A LEADER*
      - ALPHA BRO
        - HIGH FIVE!
          - *THE POWER OF POSITIVE DOG TRAINING*
      - BOTH!
        - LINKEDIN APP
  - SUPER-SKETCHY LATE-NIGHT UBER DRIVER
    - WHAT KIND OF SKETCHY?
      - HE KEEPS ASKING ME TO SUPPORT HIS KICKSTARTER.
        - SUBWAY MAP
      - HE'S PLAYING A HOOBASTANK CD. HOOBA-STANK! ON CD! IN 2015!
        - *HOW TO KILL A MAN WITH YOUR BARE HANDS*
      - THE CAR REEKS OF WEED.
        - SUBWAY MENU
      - HIS CAR IS A FULLY LOADED TESLA, AND HE SAYS HE FOUNDED A SUCCESSFUL STARTUP.
        - ANGEL INVESTORS DRIVE FOR UBER?
          - WELL, THEY'RE NOT GOING TO SLUM IT AT LYFT!
            - *HOW TO WIN FRIENDS AND INFLUENCE PEOPLE*
  - SERIES B FUNDING ROUND
    - DID YOU HAVE A STRONG SERIES A?
      - NOT REALLY.
        - *THE LEAN STARTUP*
      - IT WAS JUST, UH, $200. FROM MY MOM.
        - *UNICORNS FOR DUMMIES*
      - YES, BUT WE SPENT IT ALL ON HOVERBOARDS AND SOYLENT.
        - WHO'S YOUR DREAM VC FIRM?
          - KLEINER
            - *LEAN IN*
          - SEQUOIA
            - *THE ART OF WAR*
          - FOUNDERS FUND
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